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ENGINEERING AND
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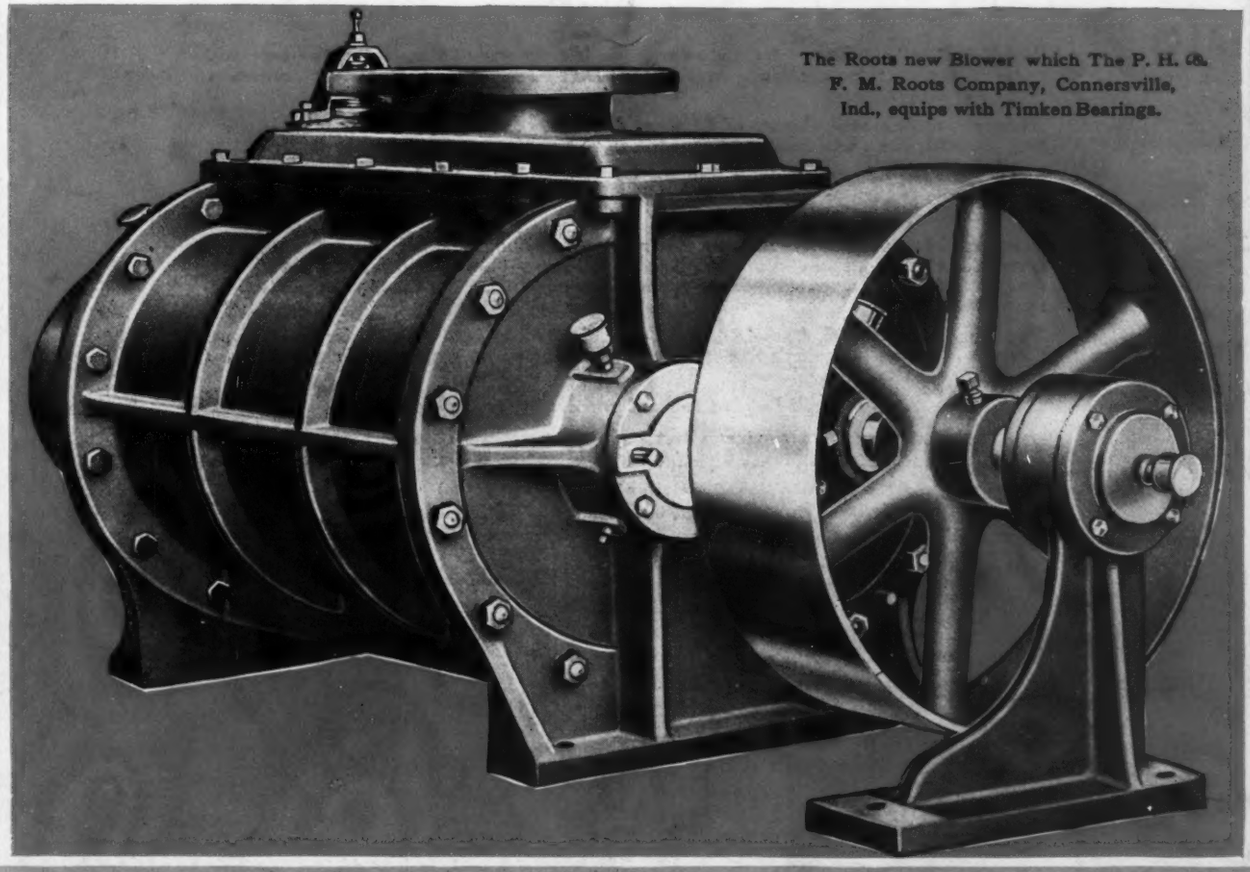

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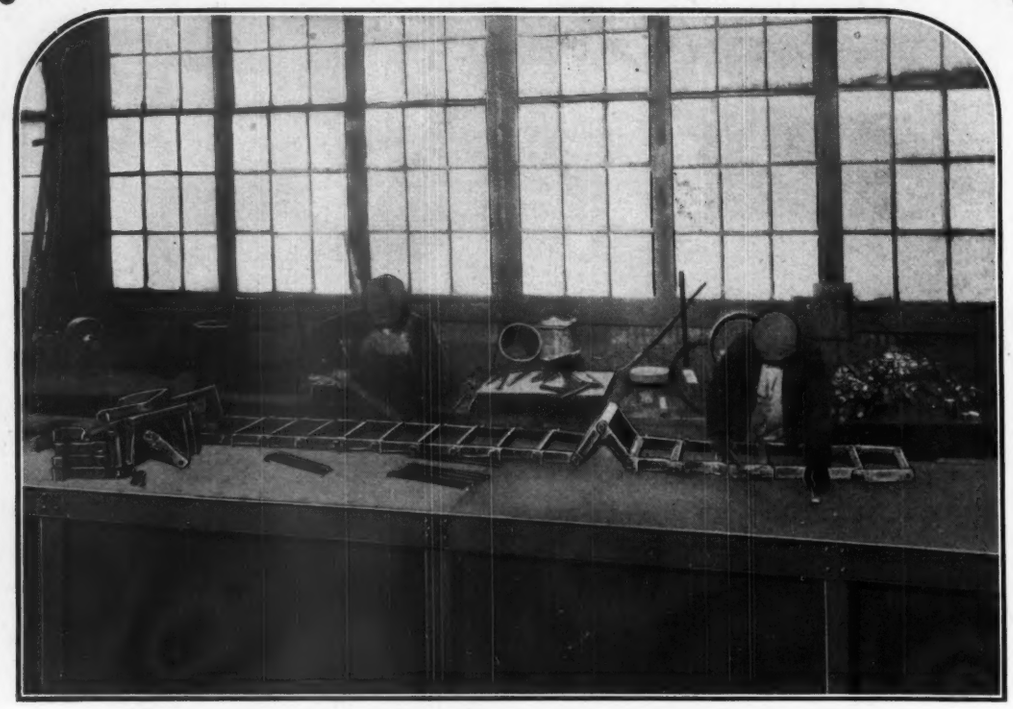

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Volume 127

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Number 13

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A. W. ALLEN, *Editor*

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New York, March 30, 1929

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EDITORIALS are the only part of the magazine for which the editorial staff asks no direct co-operation from the mining fraternity, though suggestions as to topics to be discussed are always welcome. The mining field is a wide one—geology, mining, milling, metallurgy, economics; the Americas, Europe, Africa, Asia, and Australia—and from the livest topics in its various branches the editors derive their weekly inspiration. Our editorials form a critical appreciation of what mining men are thinking and doing. Leadership in pointing the way to the successful economic development of the world's mineral resources is the editors' objective.

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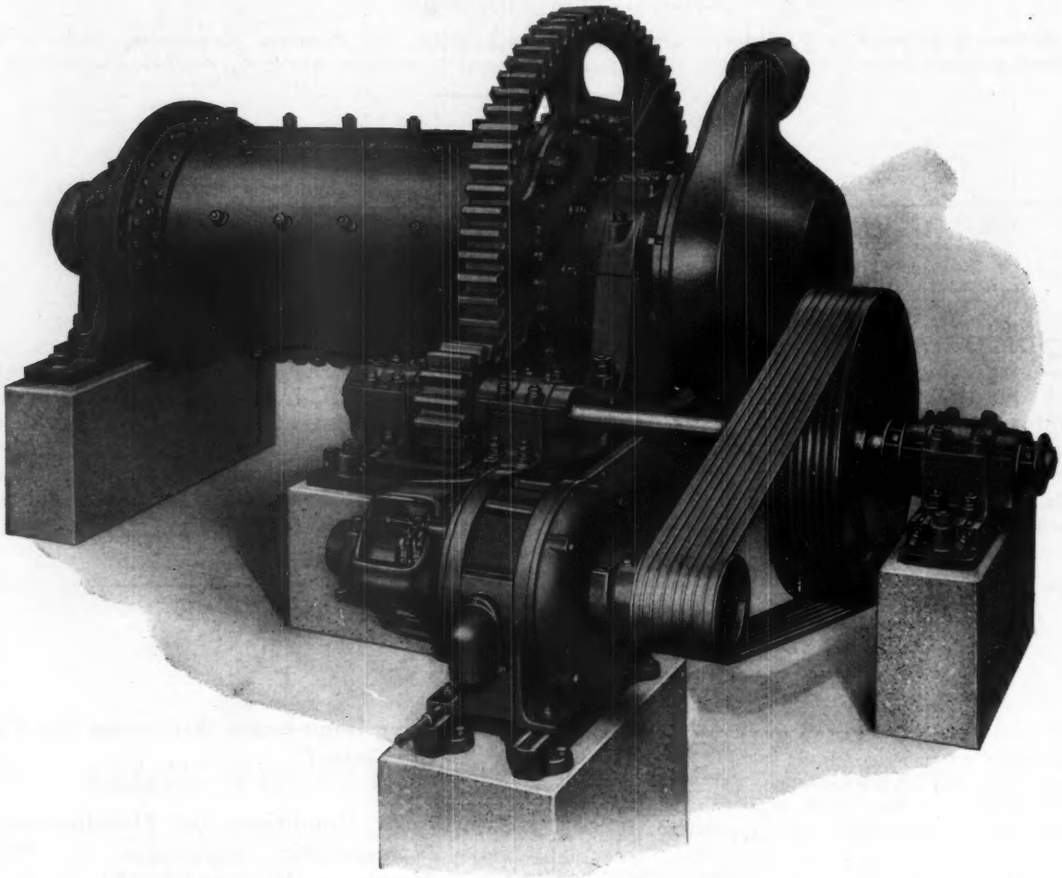

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Stabilization of Copper Prices Fails

THOUGH a measure of intelligent control of the copper industry has been secured by the good offices of such organizations as the Copper Institute; Copper Exporters, Incorporated; and the American Bureau of Metal Statistics, any attempt at price stabilization that may have been made by the individuals that compose these organizations has signally failed in the last few weeks. Months ago, when the demand for copper began to improve to such an extent that current production was more than absorbed, producers, armed with the increased knowledge of their industry secured by a study of the data collected by the organizations named, had the good sense to pursue a waiting policy between buying waves, refraining from cutting prices in temporary periods of market inactivity. As a result, prices were very stable for months around fourteen cents a pound and a little above. Even when the demand increased to such an extent as to tax productive facilities, the advance in price was orderly; had the old conditions obtained it seems likely that the price in the closing months of 1928 would have been well over twenty cents. Followers of the market can well remember when a government investigation was suggested after an advance of a full quarter of a cent in prices in one or two days. In the last two or three weeks, however, all restraint has been abandoned. At the time of writing, prices have thrice been advanced a full cent at a time, and the old law of supply and demand seems to be the only thing considered in naming quotations.

Many people will ask why the copper producers should not get all they can for their product, make hay while the sun shines, as the saying is, and thus make up for some of the lean years they have experienced since the war. The chief answer to this is that excessively high or excessively low prices make for instability of the industry and bring undesirable aftermaths. Prices are likely to drop as fast as they have risen after such conditions as are now being exhibited in the copper market have passed.

The situation with regard to lead some years ago was not unlike that of copper more recently, in some of its fundamentals. After a starvation period for the lead producers, with prices between four and five cents, in 1921, consumption increased rapidly, the tight situation in the market causing continuous advances over the next four years, until the price got above ten cents in 1925—more than a hundred per cent rise. Everything looked rosy. Then, in 1926, the rate of increase in lead consumption declined, and in 1927 the United States used less lead than in 1926, by sixty thousand tons. The price in the early months of 1925 dropped as fast as it had risen, then shot up in the summer and fall, then dropped rapidly again in the winter and spring of 1926, only to jump back up to nine cents in the summer of that year, followed by a continuous decline extending to the summer of 1927, since when a fair degree of stability has existed. Somewhat the same conditions may be expected in copper if fancy rather than intelligence is given free rein.

How do the business men of the country view the recent advances in copper prices? Wall Street has a way of appraising industrial conditions from the collective standpoint that rarely goes wrong. If the rapid advance in copper prices was considered a good thing for the industry, the prices of shares of the copper companies should reflect that fact. Suppose we take a dozen of the leading coppers and see what happened to them following the three advances in the price of the metal each of a full cent a pound last week. The price advance on the eighteenth was known early in the day, so the share quotations for that day are considered; the advances on the twentieth and twenty-second were not known until the end of the day, so the next day's values are used:

	Net Changes in Share Prices			
	March 18	March 21	March 23	Entire Week
Anaconda	— 7/8	—1 3/8	—5 1/4	+ 3/8
Andes	—1 1/8	—1 3/8	—1	—4
Calumet & Arizona	—2 3/4	— 1/8	—3	—5 7/8
Calumet & Hecla	— 1/2	— 1/2	— 5/8	—2 7/8
Cerro de Pasco	—1 1/4	—1	—1 1/2	—5 1/4
Chile	—1	—1 1/4	—1 5/8	+ 1/2
Inspiration	—1 1/8	— 7/8	—1 1/8	—3 1/8
Kennecott	— 1/4	—1	—2 1/8	—7 1/4
Magma	— 1/8	+2 1/8	— 7/8	— 3/8
Miami	— 1/4	— 5/8	— 1/8	—2 1/4
Nevada Consolidated	— 1/4	—1 1/8	—1 1/8	—3 3/4
Noranda	— 5/8	+3 1/8	—1 1/8	—3 5/8

Granted a reactionary share market, there was no evidence of enthusiasm for the future of coppers in the face of a three-cent advance in metal price.

Engineering and Mining Journal does not attempt to say what is a fair price for copper. Furthermore, it believes that the recent advance has been justified purely by supply and demand. But it fears that recent rapid advances in quotations are dangerous and are likely to be followed by a more or less lengthly period of price instability that may be regretted later. Let producers merely refuse to quote if they have no copper to offer freely in the market. Regular customers can probably be taken care of when the time comes for real need for the metal and should not be panic-stricken. Thirty cents will bring little more copper out of the mines than will twenty-four cents.

The Wrong Way to Attract Business

HOW far a legislature can go in inquiring into the intimate affairs of private companies engaged in producing a much used commodity like cement is apparently to be determined in California.

A legislative investigation of the cement industry of the state was initiated by the California Legislature now in session. It was looked upon as a fishing expedition, and proceeded casually enough until the committee demanded books and cost details from the officials of some of the cement companies. This information was refused on the ground that no combination in restraint of trade had been proved. However, the Senate adopted the Inman resolution declaring ten executives of California cement companies "guilty of contempt of the Senate," and ordered them committed to the county jail for refusal to answer certain questions and to produce books and records held by them to be private business secrets.

The cement industry of California is on a stabilized basis. The state is abundantly supplied with cement plants, most of which operate at less than capacity. These plants are situated so that the business is more or less evenly divided, and by reason of the absence of price cutting the industry is moderately prosperous. It is an important element in the industrial prosperity of the state.

On the other hand, there is a superabundance of political activity which finds a partial outlet in thumping "big business," the ballyhoo of the small politician. Likewise, there is a frantic endeavor on the part of numerous local chambers of commerce and a statewide organization to persuade industries to come to California and to contribute to its payroll. The paradox is obvious. For a state that needs industrial establishments, the experience of the cement producers is not a good object lesson in attracting it. Lack of harmony between political elements and public promotion in California indicates the great need of a thorough reorganization of the California political point of view. All that industry requires is a square deal. Manifestly, in this instance of the cement producers, fair treatment is conspicuous by its absence.

A Desirable Change in the Tariff Act

WITH all the demands upon the House Ways and Means Committee for increases in the tariff, it must be refreshing to that body to have such a constructive suggestion as that filed recently by the Lead Industries Association, which, if acted upon favorably, should have the effect of increasing industrial activity in the United States at the expense of no consuming group. It would let down a trade barrier, which economists tell us is a step in the right direction.

The subject has to do with the manufacture, in the United States, of a dutiable imported raw material, the duty being refunded on the exportation of the finished article as provided in Section 313 of the tariff act of 1922. Specifically, the Lead Industries Association has found that the execution of this law works a hardship on domestic lead manufacturers who would like to engage in export trade, despite the fact that the plain intent of the law is to favor them. These manufacturers, when engaged on work for export, naturally wish to use imported lead, which, selling at a lower price, enables them to compete with the foreign manufacturer. They, of course, pay the duty, which is refunded as a drawback when the article is exported. The hitch comes in the fact that the identical lead that is imported must be used in making the article for export, thus requiring one part of the manufacturer's plant to be set apart strictly for export work. Unless export trade is a major part of his business, it is obviously a hardship thus to segregate one section of his furnaces, mills, or other equipment, for exclusively export manufacture. The manufacturer should be allowed to transfer the drawback privilege from a given lot of imported lead to an equivalent weight of unidentifiable lead, as the Association petitions. The lead, of course, would be imported as at present, but it would be mixed with other lead and would lose its identity, so that the manufactured product for both foreign and domestic use would likely contain part imported and part domestic lead.

The provision in the tariff for segregation probably arose from the fact that in the case of some commodities grading is complex and difficult, and if the raw materials were mixed a different material would be exported from that imported. But imported lead is of the same grade as domestic lead: the lead atom, like the leopard, cannot change its spots.

How Does Mining Rate With the Prospective Undergraduate?

RESULTS of an educational investigation recently made by *Engineering and Mining Journal*, details of which appear elsewhere in this issue, indicate that only about 200 students in mining engineering will graduate next June from the mining schools in the United States. Little change in the number of such graduates, moreover, is to be expected in the next two or three years, if recent "mortality" rates for undergraduates in progressing toward a diploma are used as a basis for prediction.

Aside from all other considerations involved—and there are many—mining engineering evidently does not have the appeal for the prospective undergraduate today that it has had. As the number of students at the institutions of higher learning is increasing, and enrollments in numerous other technical courses are expanding, the decrease in the number of students pursuing courses in mining engineering would seem to warrant the close attention of the industry as well as that of the educational authorities.

Numerous comments have been made by representatives of the large organizations of the mining industry to the effect that they desire graduates with a good training in fundamentals rather than with a specialized technical education. The course in mining engineering, as offered by most educational institutions, is the broadest engineering course available, and for this reason would seem to be in accord with this expression of industry.

In the final analysis, an explanation of the situation may, perhaps, be found in the attitude of the prospective undergraduate, who, in most instances, makes the decision, prior to entering college, as to what field of endeavor he intends to enter. If interested in technical professions, he has a wide field today from which to choose, and the opportunities offered by each profession or by several professions are, to at least some extent, carefully weighed. In other words, the technical courses offered by educational institutions are today in keener competition with each other, as far as the prospective undergraduate is concerned, than ever before. The situation in general is, of course, not new. But if the mining industry is to obtain the best young men of the country, and in sufficient numbers, inducements to the prospective undergraduate to enter the field of mining engineering should equal those of the other engineering professions.

Seek New Opportunities Instead of Fighting Competitors

WRITING in the *Saturday Review of Literature,* Mr. Philip Kerr, who took an active part in the peace negotiations when secretary to Mr. Lloyd George, points the way that will lead to international amity and a wider prosperity. "It is sometimes said," he recalls, "that an irrepressible conflict must arise between Great Britain and the United States and other leading economic powers, each struggling for raw material supplies or for the lion's share of the markets of the world. There will be competition and friction, no doubt," one is reminded; "but there need be no irrepressible conflict if wisdom governs their policies. The world is on the verge of an expansion of production and exchange hitherto undreamed of—an expansion which will keep all the industrial nations fully employed on a rising standard of living for an indefinite period, if the leading nations can prevent war among themselves. The equipment with power and machines of the 1,200,000,000 of the human race now mainly dependent on human and animal energy will give them a producing and therefore a consuming capacity which will not only immensely heighten their own standard of living, but create a world market immeasurably greater than any yet conceived. If the industrial nations, following the intelligent capitalization of the present era, recognize that the key to their own problems is not internecine competition for a limited market, but the intelligent expansion of the world market through judicious investment and good wages, and the rationalization of competition within it, no irresponsible conflicts need arise."

An industrial progression into new fields is needed, perhaps more than aggressiveness, to insure an adequate market for the mass production that is essential to fair wages, low unit costs, and high industrial efficiency. Industry in general must turn more to research in economics and marketing, to discover and to make opportunities. Competition, like war, is futile so long as it merely serves to weaken the contestants, leaving an unhealthy dominance of power, on the one hand, and the extinction of worthy effort, on the other. An obvious solution of the problem of world peace lies in an intelligent expansion of the markets of the world.

When the Wish Is Father to the Thought

THE BELIEF is still held in certain quarters that the United States is riding for a fall, that its economic foundations are insecure, that its vaunted prosperity is merely the result of a process that may be described as "lifting oneself by one's bootstraps." Evidence is at hand to show that this spirit of pessimism has penetrated into domestic circles, to find lodgment in the minds of disgruntled politicians and professional writers anxious to feature a new sensational topic. Mr. Elmer Davis, in *Harpers,* paints a harrowing picture of what will happen "If Hoover Fails." Examination, however, permits the deduction that his anxiety is a natural sequel to his choice for President. He voted for Mr. Hoover's opponent as being "more courageous," thereby excusing a decision on grounds that defy analysis from the moral or the intellectual standpoint.

Mr. Davis doubts the permanence of a condition of greater comfort and wider content that is based on the stimulation of buying power among all classes. He deplores an economic system that makes opportunity equal among rich and poor in the attainment of a happiness derived from possession and variety. He decries installment buying, but he fails to dispute its economic justification as proved by the contention that the financing of the buyer is as logical as the financing of the producer, a contention that has been more and more accepted as its justice has been realized.

"Obsolescence," one is told, "means throwing away something that is still good enough and getting something better, at least newer." Mr. Davis, in the violence of his opinions, gives a slovenly definition of a word the correct meaning of which is familiar to all literate readers. The inference is plain, however: American employment and American content are based on waste! To this challenge one can make answer that had American industry retained old methods and old machinery because they might be considered "good enough," Mr. Davis would have long since felt the ill effects of so unprogressive a policy. The ruthless scrapping of the obsolete has been both wise and essential. To meet competition and service demands, moral and material, nothing but the best and the most efficient is good enough. The cheapening of a product is invariably the outcome of an expensive modernization program both in process and in equipment.

"Our prosperity is a quantity prosperity. . . . We turn in last year's car for a new model . . ." and so on. Such statements disdain facts. Let Mr. Davis compare the annual sales with the total registration of automobiles in the United States and he will find that those with whom he associates himself comprise but a small percentage of the population, for the life of a car averages seven years. He has fallen into the common error of indicting a nation after having observed the antics of a few in the spotlight.

"If Hoover Fails" may be an example of smart journalism, but it presupposes the improbable. Mr. Davis should investigate the achievement records of his political friends. The result should explain why the engineer's philosophy of courageously facing facts makes for ultimate success. Unless President Hoover's progress meets an unexpected check by politics and propaganda, he will not fail.

THE RE-TREATMENT of tin tailing in Bolivia provides occupation and yields a livelihood for both sexes, young and old

WHERE ORE DRESSING IS A FAMILY AFFAIR

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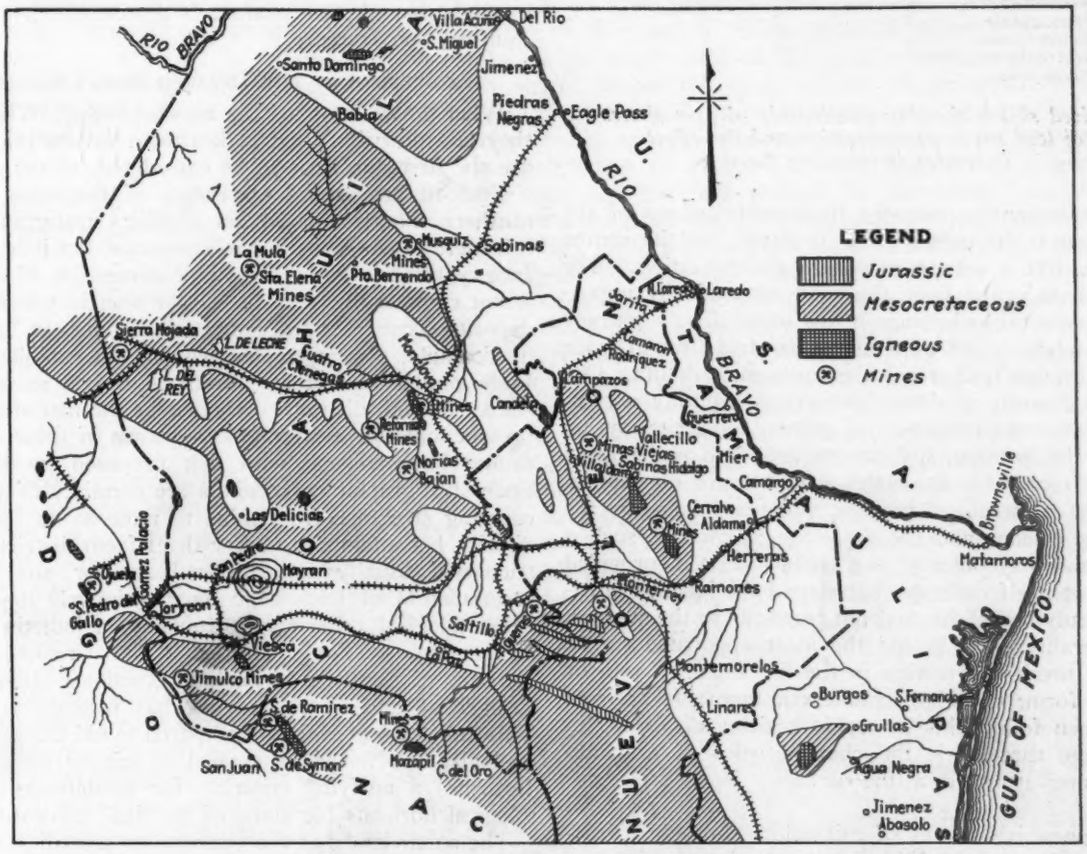
Mexico's Lead-Silver Manto Deposits and Their Origin

By A. R. FLETCHER

MEXICO'S SMELTING INDUSTRY is dependent on ores derived from its lead-silver deposits occurring in limestone. During the last few years the threatened depletion and prospective exhaustion of these deposits has stimulated a study of them that as yet is but imperfectly reflected in geological literature.

About two years ago, Mr. Basil Prescott published an article dealing with these deposits in which he adduced certain principles of occurrence, the most important of which were the following:

1. A manto orebody travels upward from its source of outcrop.
2. It is originally continuous from the source of outcrop.
3. Its cross-section varies gradually by small increments or decrements and usually increases slightly with depth.
4. Composition of the ore produced from any manto in its oxidized range is uniform in analysis.



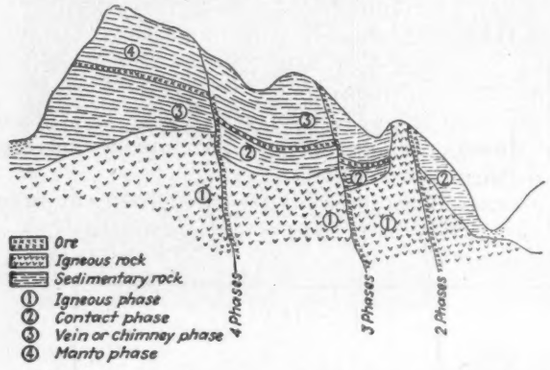
Map showing location of silver-lead mines in northeastern Mexico and their relation to Meso-Cretaceous and igneous rocks

As descriptive statements of manto characteristics, these generalizations are often true and always valuable and stimulating when one is approaching the study of a limestone lead manto. The human intellect is lazy and loves a general formula, however, and to enunciate and expound such a general formula applicable to all limestone lead mantos is the object of this article. The formula may be stated as follows:

A lead-silver orebody in its manto and precedent phases always follows the course of least resistance from its igneous source to the surface.

Factors that reduce resistance and hence determine the orebody's channel are mechanical and, in the manto phase, also textural. The mechanical factors are folding, faulting, and fracturing of the invaded rocks. These, in the manto phase, determine the course of the mineralizer through the favorable horizon, whereas texture and/or composition of the limestone determines which limestone stratum will be invaded by the mineralizer.

But what is the source of a manto orebody? It has



Idealized sketch showing relationship of four phases of lead-silver mineralization and the effect of erosion in revealing them

been the custom to consider the manifestations of the mineralizer in its manto phase in detail, and its source has been left a matter of vague generalization. The manto phase is the final, the most economically important, but not the only stage in the mineralizer's journey to the surface. The mineralizer has had first to work its way through fractures in the basement batholith. Ore which it deposits in these fractures is typically a complex sulphide ore composed of galena, sphalerite, pyrite, arsenopyrite, stibnite, and jamesonite. Ore as deposited in these fractures is associated with little or no gangue. After the mineralizer reaches a contact between the intruding igneous and the limestone, it ascends such a contact and may outcrop as a contact deposit, provided the contact itself outcrops, but should the igneous intrusion be truly batholithic and not penetrate to the surface, the mineralizer will ascend the most opportune simple break or break intersection in the limestone, in vein or chimney form, until it encounters a favorable horizon. It will then follow this favorable horizon, displaying in its passage through it the characteristics of a manto deposit, until it arrives at the surface.

The successive phases of migration, through a fractured zone in the batholithic basement, along an igneous lime contact, ascent through limestone to a favorable horizon, and travel in that horizon as a manto orebody to the surface, all display one characteristic in common, which is that the mineralizer in all these phases follows the course of least resistance presented to it by each of its successive environments.

From the practical standpoint, if it be admitted that the mineralizer always follows the line of least resistance presented to it from source to surface, a study of the factors that reduce resistance would evidently aid in predicting the course of an orebody, and a complete understanding of all the factors that reduce resistance would enable one to predict their resultant effect; or, in other words, the course of the orebody would be completely known. Unfortunately, field observation never reveals all of the facts upon which to build this complete prediction, and the most that can be expected in the case of individual orebodies or particular districts is to decipher enough facts to enable men, instead of blindly groping for ore, to seek it with the self-respect of a rationalized hope of sometime finding it. Despite such an unsatisfactory state of affairs—in fact, because it exists—I feel that it may be worth while to systematize such knowledge as I possess on this subject by expressing it, not only to increase the effectiveness of its use but to emphasize its deficiencies as well.

Summarizing, to secure a point of departure for detailed discussion, the assertion has been made that the type of mineralization under consideration presents four successive zonal phases. These are, in order of ascension, the igneous, the contact, the vein or chimney, and, finally, the manto. The statement has also been made that in the manto phase the stratum chosen for invasion by the mineralizer is chosen because of its texture and/or composition and that the course of the mineralizer through that elected stratum is determined by folding, faulting, and fracture.

Knowledge of the Invaded Beds Desirable

What do we know of the invaded beds? When were they laid down? What makes them favorable? These are the first questions to be considered, in my opinion.

Prescott proposed a correlation of limestone beds in northern Mexico based on similar stratigraphy and lithologic resemblance in various camps, but it is unsatisfactory because the stratigraphic succession of Prescott is not co-extensive with the larger area in which manto deposits occur. At the Santa Elena mine, at La Mula, in Coahuila, a stratigraphic sequence is exhibited strikingly similar to that at Norias de Bajan, in the same state. In both districts, orebodies of the manto type are present, but the stratigraphic sequence in these districts cannot be correlated with that proposed by Prescott. Such stratigraphic correlations are certainly of value in carrying structure from mine to mine in an individual district, but attempts to carry them from district to district will usually fail. The basis for any orderly accumulation of knowledge must ultimately depend on paleontological criteria. Fortunately, a bulletin of the University of Texas entitled "The Cretaceous and Tertiary of Southern Texas and Northern Mexico," by Emil Böse and O. A. Cavins, has recently appeared. This bulletin was evidently prepared to aid the petroleum geologist, but it can be applied to mining geology and furnishes a unifying criterion for establishing paleontological horizons for some of our lead manto deposits.

The subdivisions of the Cretaceous, according to these authors, follow:

	Stage	*Description*
Supra-Cretaceous:	Maestrichtian Campanian	Largely sandstone and shales
	Santonian Coniacian Turonian	Mostly shales and marls with beds of limestone
Meso-Cretaceous:	Cenomanian Albian Aptian	Large mass of thick- and thin-bedded limestone with intercalation of shales and marls
Infra-Cretaceous:	Barremian Hauterivian Valanginian Berriasian	Thin-bedded limestone with intercalations of marls

Mr. Cavins has courteously furnished me with a print of the base map used in preparing the reduced copy that accompanies his bulletin. The map illustrating the present article, although following his in essentials, has been modified somewhat. The Meso-Cretaceous only is shown, and its outlines are slightly extended; also the locations of mines, not shown in his map, have been added, as have certain igneous areas. Igneous areas are not differentiated in my adaptation with regard to physical character as they are in Cavins' original map. The reason is that irrespective of local character, whether intrusive or flow, they seem to me to represent the same period of Tertiary intrusion. I believe that any flow area in the region covered by the map could be traced to an intrusion in the immediate vicinity, and it can therefore be used to represent it. This would not be true if the mapped area were extended to embrace country farther to the west. In other words, the map presented in this article is intended to show as simply as possible the relationship of the Meso-Cretaceous, the igneous, and the mines in the area it covers.

Reference to the map will reveal the important fact that all of the mines occur in the Meso-Cretaceous.

A closer allocation, referring these mining districts to the stage of the Meso-Cretaceous in which they occur, has been tentatively attempted and is given:

District	*State*	*Stage*
Sierra de Ramirez	Coahuila	Aptian
Concepcion del Oro	Zacatecas	Aptian
Minas Viejas	Nuevo Leon	Albian
Reforma	Coahuila	Aptian
Norias de Bajan	Coahuila	Albian
Santa Elena	Coahuila	Albian
Musquiz	Coahuila	Albian
Vicinity of Monterey	Nuevo Leon	Aptian
Sierra Mojada	Coahuila	Albian
Higueras	Coahuila	Aptian
Cerralvo	Nuevo Leon	(?)

These mines occur in limestones deposited by reef builders and other in-shore fauna in a shallow, gradually shelving, and tepid sea. Furthermore, the map shows sufficient to warrant the presumption that if we had an accurate map of the Meso-Cretaceous areas in Mexico, it would also represent, define, and limit lead manto possibilities and consequently the area worth prospecting.

Of course, the vast majority of the beds in the two favorable stages of the Meso-Cretaceous are barren; an explanation should be given as to why a favored few are not. In preceding paragraphs the statement has been reiterated, possibly *ad nauseam,* that the texture and/or composition of the limestone beds determined their susceptibility to invasion by the mineralizer. The matter of composition has been judged so important by one company operating in the Santa Eulalia district of Chihuahua that its analyses of limestones are said to have reached several thousand, and more are being made. All this work is probably being done to determine some of the chemically identifiable characteristics of favorable horizons in one property of one district.

Why Are Some Beds Favorable to Invasion

Little—too little by far—is known of the qualities that make some beds favorable to invasion by the mineralizer. One characteristic, however, has been well authenticated and received some study, and that is magnesian content. At Sierra Mojada, for example, the manto beds over considerable areas have constant compositions; one will contain 14 per cent MgO, varying from that magnesian content by only 1 per cent at most; another will have a typical analysis of 18 per cent MgO. In general, analyses vary between 13 and 20 per cent MgO, which is a typical range for the magnesian content of the beds in this camp as well as those in other parts of Mexico that act as hosts for mineralizers. The further observation has been made that at Sierra Mojada analyses from the beds immediately above and below one of these magnesian strata will show a content of only 1 to 2 per cent MgO.

How did the magnesium get into some beds and at the same time keep out of the ones immediately above and below them? Two possibilities exist. One is that the fauna, whose remains constitute these beds, had the property of incorporating magnesium as well as calcium. Clarke, in his "Data of Geochemistry," calls attention to the fact that certain marine faunas have possessed this property. The other assumption is that the magnesian salts in the sea water of the shallow Cretaceous sea replaced to some extent the calcium salts. If this alternative is accepted, a reason must be given why this affinity for magnesium should exist in one bed and not be shared by the bed above or the one below it. The sea under which all three beds were deposited probably remained of approximately constant composition through a much longer time than it took to form the beds, and yet only the one bed is high in magnesian content. Either assumption therefore demands the same premise to make it tenable—namely, the character of these dolomitic horizons has been determined by a fauna peculiar to them. Either that fauna absorbed and incorporated magnesium directly from the sea, or its character was such that the texture of the limestone produced by its remains proved more inviting to replacement by magnesium than that of the different fauna that produced the subjacent and overlying beds notably poor in MgO. If dolomitic beds were not usually easy to recognize at their outcrops, more analyses would probably have been made. In the Minas Viejas district of Nuevo Leon, the outcropping magnesian beds weather characteritically to a surface that can be instantly identified, as it is about the same color and texture as elephant hide. This distinctive weathering can be fairly assumed here and elsewhere to indicate a distinctive texture.

Texture of Invaded Beds Permitted Magnesian Replacement

I believe that the property of these beds which lent itself to magnesian replacement was the same one which later made them amenable to replacement by the mineralizer. It is their texture, and not the magnesian element of their composition, which was responsible for the mineralizer's invasion.

Magnesian content is not by any means an essential characteristic of a favorable horizon. At Santa Eulalia the productive upper and lower fossil horizons are not characterized by high magnesian content, it is said. The San Agustin mine, in the Sierra de Ramirez district of Coahuila, presents beautifully typical manto orebodies but shows no magnesian content of the mineralized beds.

At a small mine called the Ojuela, near Villa Garcia, between Monterey and Saltillo, ore occurs in a bed having no magnesian content, and less than 100 ft. above it is a bed in which no ore has as yet been found but which contains 20 per cent MgO.

That magnesian content is the most important index we have for favorable horizons remains true nevertheless. Favorable horizons, where not dolomitic, are pure and reasonably thick. Thin beds and those high in silica, alumina, and carbon are unfavorable. In other words, where conditions at the time of deposition of the limestone fluctuated rapidly, resulting in thin and impure beds, they were unfavorable. Propitious horizons occur where conditions were only slowly changing over long periods of time and especially where they favored the building of reefs now represented by thick members of the deposited series. Dolomitization of thick beds, such as occur at Higueras and at the Diente mine, near Monterey, has not been studied as it should have been, and it is not yet known whether the magnesian content has the characteristic of uniform analysis which typifies the beds of Sierra Mojada.

The reader now sees how little is known as to what makes horizons favorable and reduces their resistance to the invading force of the mineralizer. Discussion of the factors which reduce resistance to that force in the favorable horizon itself is therefore pertinent. These factors are structural, and, in the order of their importance, are fracture, folding, and faulting. In my study of the thinner manto deposits of Mexico, I have yet to encounter an instance where such control was absent. Possibly in the thicker mantos, the evidence of control may have been obliterated in certain formations by the replacement that occurred along its course, but the control almost certainly did exist and did determine the course of the orebody in its migration through the favorable horizon.

Formerly fractures were thought to be feeders of this type of orebody, and when it was later realized that this was not so, the tendency was to go to the other extreme and minimize unduly the importance of the rôle played by them and by structure in general.

The truth is that fractures, faults, and structure control the course of mineralization within the favorable horizon. They may permit escape from that horizon at any point, but only at one point do they permit access to it.

Fractures also may open to imposing proportions in the favorable horizon where they control ore deposition and narrow to a knife edge where they cut the beds above and below the favorable horizon. Should more than one favorable horizon exist, however, these same fractures may again become of importance where they traverse those horizons and may again control channels of mineralization in them. Where more than one favorable horizon is known to exist, it is important to establish the pattern of the control exercised by structural features in the best-known horizon, inasmuch as the same pattern may be super-imposable and control mineralization in the less well-explored horizons. Minas Viejas is an excellent example of a mine where the same fractures control deposition in more than one horizon, occasionally pinching to insignificance between them.

Most of these lead-silver districts are associated with anticlinal structure. This is due in part to the fact that anticlines form mountains where outcrops are revealed and mines are discovered, whereas synclines are likely to be filled with valley wash. Also, these manto orebodies travel uphill and so are likely to outcrop in the anticlinal elements of structure. Anticlinal folding, presupposing as it does the bending of a rigid structure originally laid down in a horizontal position, leads to the development of fractures and faults which furnish the channels for ore deposition. In none of the mines that I visited has anticlinal structure been absent, although in some instances the crests of the anticlines have been eroded. Anticlinal structure where the folding has been so severe as to result in crustal failure along the vertical axial plane of the anticline often permits of batholithic approach under the arch, and the secondary fracturing associated with the adjustment of stresses along such a plane of failure, after intrusion, gives the mineralizer its chance to ascend into the limestone.

The Santa Elena mine, in northern Coahuila, illustrates this condition very well. The crushed crest of its anticline has been eroded, forming a valley, and erosion has progressed to a point where the batholith is just revealed in the valley floor. Mineralization occurs in the limestone which forms the flanks of the valley, and the main channel of mineralization is governed by the intersection of sheeted thrust faults striking parallel to the axis of the anticline and hence paralleling the valley.

Faults along which considerable displacement has occurred are likely to act as dams in the ore channel and deflect its course. It is a fact not realized by most geologists that at least 90 per cent of such faults in the Mexican Cordillera are pre-mineral, and hence do not mechanically offset the orebodies that abut them. The diagnosis of faults is extremely difficult and should be undertaken humbly. Small post-mineral movements frequently occur along the planes of these pre-mineral faults, giving them a specious post-mineral semblance. The easy but erroneous conclusion is that the orebody has been offset an amount equal to the entire fault displacement. Really, it is more probable that its course has been deflected, and possibly also slightly dislocated, by the small amount of the post-mineral fault movement.

A fault is more likely than a fracture to be the channel of entry used by the mineralizer in reaching the favorable horizon. Being a plane of displacement, a fault cuts deeper than a fracture, which is only a simple break.

At the Diente mine, near Monterey, a system of step faults breaks the favorable horizon bed into a series of blocks, and geologists persist in assuming that these are post-mineral faults. Once this assumption is made, a manto orebody occurring in any block must be assumed as having offset continuations in the adjacent blocks, and brilliant predictions may be made. The fact has been ignored that in one case at least an orebody was found and mined in one of these fault planes outside the favorable bed. I believe that these faults in certain instances provided the mineralizer with its channels of ingress into the favorable horizon and that they are the links that connect it with the batholithic source of the ore. At any rate, none of the predictions made on the assumption of post-mineral faulting have been realized in this mine.

Summarizing to this point, it has been shown that a favorable bed, probably of the Meso-Cretaceous, often dolomitic, usually in an anticlinal attitude and traversed by fractures, constitutes the typical environment of a lead-silver orebody in its manto phase.

The Manto Is Only a Phase

Now I must show that the manto phase is only a phase, that it represents only one element in a unity, that its parent was a vein or chimney, that its grandparent was a contact deposit, and that its great grandparent was a breccia or fracture deposit in the igneous.

The districts that displayed this zonal arrangement conclusively are not ones commonly studied by the lime-

stone geologists. In the Doctor mineral district, in Queretaro, the complete sequence is present in one small mine called Valenciana. A breccia phase in the igneous is followed by a contact phase and an outcropping manto. These are all observed in ascending sequence, but the mine workings do not reveal the places where transition has taken place, as the orebody at such places was not profitable enough to mine. However, no question exists as to the identity of the orebody in its three plases. In the Negra mine, in the same district, is a beautiful example of the igneous phase, and alongside it in the limestone, and not 500 ft. distant, is a perfect manto, but the connecting links of the contact and transition phases are lacking. The Doctor mine, which has given its name to the district, shows the manto phase only, and this manto orebody has been mined for more than 3,000 ft. from its outcrop.

The transition phase between contact and manto is, however, not lacking in the district. It is beautifully exemplified in the Bronzes manto of the Santo Entierro mine. The ore of the Bronzes manto rises under the gable formed by the acute intersection of two blind dikes which penetrate the limestone. It then mantos off through the limestone, and is deflected by a fault, which it follows until another favorable bed is reached. The orebody then leaves the fault and mantos along this bed to the surface.

In the Pinal de Amoles district, in Queretaro, is the Animas manto, about 3,000 ft. long, with its source in the Queso chimney, which occurs at the contact of igneous rock and limestone. In this case, there is present a transition phase which is typical. The Queso chimney is well defined, the Animas manto is a perfect manto, but the connecting fracture system is poorly defined. This transition phase from a batholithic contact to a favorable horizon is, however, responsible for some mines in Mexico, because in certain instances no favorable limestone horizon was encountered before the surface was reached. The San Acacio and Tres Rosas mines, in the northern end of the Sierra de Ramirez district, exemplify this type of mine. Ore occurs in veins in the limestone, and the considerable deposits are determined by fracture intersections. The fractures themselves result from bending of the strata.

No silver-lead mine in Mexico in the Cordilleran province is far from its igneous source, despite the fact that such a source may not yet have been found. This may be stated confidently. At Santa Eulalia, in Chihuahua, such a source has not been found, but ores carrying as high as 3½ per cent tin are being found, and methods for the recovery of this tin are said to be under consideration. Tin ores are usually assumed to have an igneous source.

An idealized sketch has been prepared showing the progress of a silver-lead mineralizer from source to surface and how erosion may effect its manifestations. In one of the accompanying tables a list of mining districts is given which classifies the mines of the districts with respect to their position in the zonal arrangement herein discussed and which also indicates whether igneous rock is present in the immediate vicinity of the mines as outcrops.

This list of mining districts shows the igneous phases as very poorly represented, but the idealized sketch and the map of the regional geology show the reason why. The map shows that erosion has frequently revealed Tertiary batholithic areas in Mexico, but that none of them are extensive. The assumption may be made that the mineralizer had usually been able to find the easier line of egress afforded by their perimeters by the time it had risen high enough to be exposed by the present erosion surface.

In the latter part of this paper I have endeavored to give family background to the lead-silver manto deposit by showing that its progenitor was the contact deposit and its ultimate ancestor a mineralized breccia zone or fracture in igneous rock. From igneous-breccia zone to igneous-limestone contact, from contact assuming vein or chimney form via limestone fracture or faults or their intersection to a favorable limestone horizon and thence in its familiar manto phase to the surface, is the normal history of the upward progress of the mineralizer. To achieve this consummation, an element of the Tertiary igneous batholith and the limestone horizons, probably always of the Meso-Cretaceous, must be in juxtaposition. After that juxtaposition was effected, adjusting movements profound enough to traverse both formations, thus furnishing a channel from igneous to sedimentary rocks, must have occurred. These adjusting movements most frequently occur parallel to the axes of anticlines that have failed under compression, permitting batholith approach. It is probable that synclinal troughs also present conditions of failure, intrusion, and opportunity of access from igneous to sedimentary by refracturing, but such localities are not open to inspection. The sulphides typically present in the mineralizer are those of lead, zinc, iron, arsenic, and antimony.

The picture that I wish to leave in the reader's mind is of the mineralizer breaking trail successively through all its zones. Its manifestations were conditioned by its successive environments, and to similar environments it always reacted in the same way.

List of Mining Districts Showing Phases of Mineralization Present in Each District

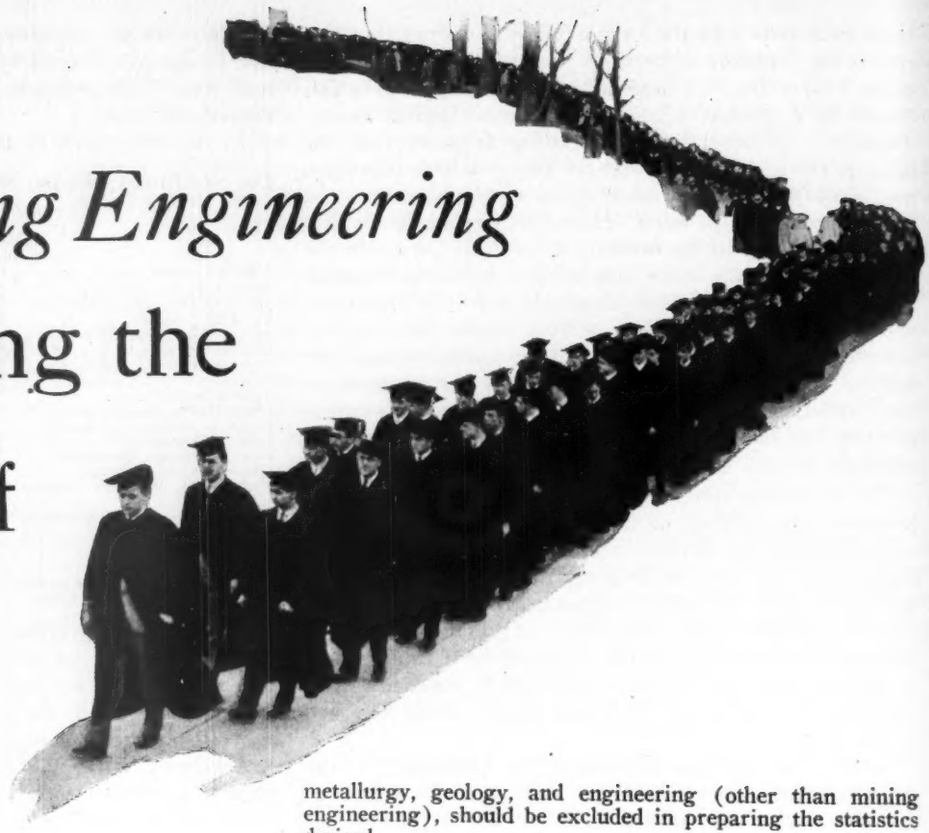
Mining District	Intrusive Igneous Rock	Igneous Phase	Contact Phase	Vein Phase	Mantos Phase
Santa Eulalia, Chihuahua	No	No	No	No	Yes
Sierra Mojada, Coahuila	Yes	No	No	No	Yes
La Mula, Coahuila	Yes	No	No	No	Yes
Minas Viejas, Nuevo Leon	No	No	No	No	Yes
Higueras, Coahuila	No	No	No	No	Yes
Concepcion del Oro, Zacatecas	Yes	(Yes)	(Yes)	(Yes)	Yes
Norias de Bajan, Coahuila	No	No	No	No	Yes
Velardeña, Durango	Yes	No	Yes	Yes	No
Chalchihuites, Zacatecas	Yes	Yes	(Yes)	(Yes)	Yes
Sierra de Ramirez, Coahuila	Yes	No	(Yes)	Yes	Yes
Doctor, Queretaro	Yes	Yes	Yes	(?)	Yes
Pinal de Amoles, Queretaro	Yes	No	Yes	Yes	Yes
Ojuela-Mapimi, Durango	Yes	No	No	No	Yes
Vicinity of Monterey, Nuevo Leon	No	No	No	No	Yes
Monclova, San Jose de Marañon, Coahuila	Yes	No	Yes	No	No
La Parilla, Durango	Yes	No	Yes	Yes	No
Musquis, Coahuila	No	No	No	No	Yes

Note: Where phase is present but not exhibited in a mine of economic consequence it is noted thus (Yes).

A New Record Established in Sulphur Production

JUST two years after the first drill hole had shown the possibility of sulphur occurring in commercial quantity at Boling dome, in the Gulf region of Texas, the Texas Gulf Sulphur Company has begun production from the deposit thus discovered. In this short period it has proved the existence of a huge tonnage and erected a modern plant as well as a town of over 300 houses—an achievement thus far without a parallel in the sulphur industry. The story will be told in the issue of April 6.

Is *Mining Engineering* Attracting the Youth of Today?



By H. D. KEISER
Assistant Editor

IN COMPILING enrollment statistics of the engineering schools in the United States, all students who are candidates for degrees in any one of the three fields of mining, geology, and metallurgy are usually considered collectively. For comparison with enrollments in other technical courses, such as electrical, civil, or mechanical engineering, this collective treatment undoubtedly serves a useful purpose. Such treatment, however, does not provide a reliable basis for gaging the extent to which mining engineering is attracting the youth of today, inasmuch as a large number of students in metallurgy have no intention of entering mining and for the reason, also, that a certain percentage of geology students contemplate employment in the oil industry. It may be well reasoned, of course, that all students in mining do not follow the profession on graduation, and that many graduates in geology enter mining, but these facts are, in the main, beside the point in question.

Obviously, detailed enrollment statistics of the mining educational institutions of the country are essential in considering the question. Such statistics *Engineering and Mining Journal* endeavored to obtain recently by sending the following letter to the authorities at the 42 educational institutions listed in the next column.

"Dear Sir:

We wish to determine to what extent the number of students in the MINING courses of the colleges and universities is increasing or decreasing. In this connection we should like to have statistics as outlined below for your institution. Please note that students enrolled in courses of metallurgy, geology, and engineering (other than mining engineering), should be excluded in preparing the statistics desired.

	Number of Mining Students			
	1925-26	1926-27	1927-28	1928-29
Freshmen	.....	.....	.....	.....
Sophomores	.....	.....	.....	.....
Juniors	.....	.....	.....	.....
Seniors	.....	.....	.....	.....
Special students	.....	.....	.....	.....
Totals				

Your co-operation in aiding us to reach an accurate and definite conclusion on this subject will be appreciated.

Very truly yours,"

Mining Educational Institutions Receiving Questionnaire

University of Alabama
Alaska Agricultural College
University of Arizona
University of California
Stanford University
Colorado School of Mines
Yale University
University of Idaho
University of Illinois
Iowa State College
University of Kansas
University of Kentucky
Massachusetts Institute of Technology
Harvard University
Michigan College of Mining and Technology
University of Minnesota
Missouri School of Mines and Metallurgy
Montana State School of Mines
University of Nevada
Princeton University
New Mexico School of Mines
Columbia University
Pennsylvania State College
South Dakota State School of Mines
University of Texas
University of Utah
Virginia Polytechnic Institute
University of Washington
State College of Washington
West Virginia University
University of Wisconsin
University of Wyoming
University of North Dakota
Case School of Applied Science
Ohio State University
University of Oklahoma
Oklahoma School of Mines and Metallurgy
Oregon State College
Carnegie Institute of Technology
Lehigh University
Lafayette College
University of Pittsburgh

BY virtue of the courteous co-operation of each of the above-named institutions, a statistical study has been possible which, although not as complete in some respects as might be desired, affords considerable information.

Table I*—Enrollment Statistics of 40 Mining Educational Institutions

Group Number	Institution Number	1925-26 Freshmen	Sophomores	Juniors	Seniors	Total	1926-27 Freshmen	Sophomores	Juniors	Seniors	Total	1927-28 Freshmen	Sophomores	Juniors	Seniors	Total	1928-29 Freshmen	Sophomores	Juniors	Seniors	Total
I	1	18	4	10	5	37	6	4	2	5	17	7	7	1	3	18	18	12	1	0	31
	2	5	8	5	4	22	1	5	8	6	20	7	4	5	6	22	8	6	5	3	22
	3	8	9	10	1	28	9	4	7	9	29	4	4	2	6	16	4	7	2	2	15
	4	9	8	11	15	43	6	9	7	10	32	15	8	3	8	34	9	5	3	3	20
	5	6	7	8	6	27	9	4	6	9	28	10	6	4	2	22	12	4	8	1	25
	6	7	2	5	4	18	7	6	0	7	20	12	10	5	1	28	10	7	10	2	29
	7	85	81	49	42	257	75	48	32	31	186	41	48	33	20	142	39	33	30	20	122
	8	10	9	6	3	28	8	5	11	3	27	9	7	9	6	31	12	12	7	6	37
	9	11	11	8	5	35	9	1	5	6	21	4	4	0	7	15	6	8	4	1	19
	10	12	6	11	13	42	13	15	18	9	55	7	10	12	6	35	15	13	11	13	52
	11	20	14	6	5	45	17	18	13	3	51	20	17	15	7	59	20	20	11	11	62
	12	16	9	8	5	38	18	15	5	7	45	12	12	8	8	40	14	12	6	5	37
	13	24	18	17	22	81	28	27	12	14	81	24	25	18	10	77	19	16	10	12	57
	14	7	7	10	10	34	5	4	7	7	23	6	7	2	7	22	9	7	8	4	28
	15	5	2	3	1	11	2	4	2	1	9	0	1	3	1	5	4	0	1	0	5
	16	3	12	7	11	33	4	16	12	9	41	2	8	6	4	20	4	12	3	4	23
	17	7	10	4	3	24	7	10	6	3	26	8	3	5	2	18	12	7	3	3	25
	18	10	5	2	5	22	12	6	6	4	28	7	4	6	4	21	13	6	9	3	31
	19	30	28	38	40	136	14	21	35	42	112	18	25	22	34	99	21	18	29	20	88
	20	2	1	2	1	6	4	0	1	1	6	3	5	1	0	9	3	1	6	1	11
	21	0	0	1	0	1	3	0	0	1	4	2	3	0	0	5	4	0	3	0	7
	22	5	2	12	2	21	1	6	3	3	13	3	3	3	3	12	2	3	3	0	8
	23	4	8	5	1	18	3	1	4	5	13	6	7	2	3	18	6	8	6	3	23
	24	3	6	4	7	20	6	7	6	6	25	7	6	8	5	26	7	5	7	7	26
	25	5	6	8	1	20	5	5	8	1	19	9	5	4	4	22	3	5	2	4	14
	Totals	312	273	250	212	1,047	272	241	216	202	931	243	239	177	157	816	274	227	188	128	817
II	26	38	30	31	28	127	38	26	28	30	122	37	29	23	27	116	(b)	22	25	22	(a)
	27	3	1	1	6	11	0	3	1	1	5	6	0	3	1	10	(b)	4	0	3	(a)
	28	15	8	15	25	63	10	12	7	15	44	(b)	7	10	9	(a)	(b)	24	5	10	(a)
	29	(b)	5	2	5	(a)	(b)	3	5	4	(a)	(b)	6	3	4	(a)	(b)	7	3	5	(a)
	30	(b)	4	1	3	(a)	(b)	4	3	1	(a)	(b)	5	3	2	(a)	(b)	3	3	3	(a)
	31	(b)	4	4	2	(a)	(b)	2	5	3	(a)	(b)	2	2	5	(a)	(b)	3	0	2	(a)
	Totals	(a)	52	54	69	(a)	(a)	50	49	54	(a)	(a)	49	44	48	(a)	(b)	63	36	45	(a)
III	32	(c)	(c)	9	5	(a)	(c)	(c)	8	3	(a)	(c)	(c)	9	3	(a)	(c)	(c)	7	2	(a)
	33	(c)	(c)	0	2	(a)	(c)	(c)	2	0	(a)	(c)	(c)	0	2	(a)	(c)	(c)	4	0	(a)
	34	(c)	(c)	10	8	(a)	(c)	(c)	3	7	(a)	(c)	(c)	5	4	(a)	(c)	(c)	7	5	(a)
	Totals	(c)	(c)	19	15	(a)	(c)	(c)	13	10	(a)	(c)	(c)	14	9	(a)	(c)	(c)	18	7	(a)
IV	35	(a)	(a)	(a)	(a)	(a)	8	3	2	5	18	18	9	5	4	36	18	19	7	5	49
	36	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	5	2	0	3	10	8	3	2	2	15
	37	(a)	(a)	(a)	9	(a)	(a)	(a)	(a)	4	(a)	(a)	(a)	(a)	7	(a)	45	24	12	11	92
	38	(b)	(a)	(a)	(a)	(a)	(b)	(a)	(a)	(a)	(a)	(b)	(a)	(a)	(a)	(a)	(b)	4	4	5	(a)
	39	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(c)	(c)	2	6	(a)
	40	34	(d)	28	27	89	57	(d)	31	25	113	66	(d)	36	24	126	46	(d)	(a)	(a)	(a)

* Special and graduate students are not included in these statistics.

(a) Figures not available.
(b) Uniform freshman year for all engineering students.
(c) Uniform freshman and sophomore years for all engineering students.
(d) Three year course.

Tables II, III, and IV—Consolidations of Statistics Presented in Table I.

Table II

Group	1925-26 Sophomores	Juniors	Seniors	Total	1926-27 Sophomores	Juniors	Seniors	Total	1927-28 Sophomores	Juniors	Seniors	Total	1928-29 Sophomores	Juniors	Seniors	Total
I	273	250	212	735	241	216	202	659	239	177	157	573	227	188	128	543
II	52	54	69	175	50	49	54	153	49	44	48	141	63	36	45	144
Totals.....	325	304	281	910	291	265	256	812	288	221	205	714	290	224	173	687

Table III

Group	1925-26 Juniors	Seniors	Total	1926-27 Juniors	Seniors	Total	1927-28 Juniors	Seniors	Total	1928-29 Juniors	Seniors	Total
I	250	212	462	216	202	418	177	157	334	188	128	316
II	54	69	123	49	54	103	44	48	92	36	45	81
III	19	15	34	13	10	23	14	9	23	18	7	25
Totals	323	296	619	278	266	544	235	214	449	242	180	422

Table IV

Group	Institutions	1927-28 Freshmen	Sophomores	Juniors	Seniors	Total	1928-29 Freshmen	Sophomores	Juniors	Seniors	Total
I	1 to 25 inclusive	243	239	177	157	816	224	227	188	128	817
IV	35 and 36	23	11	5	7	46	26	22	9	7	64
Totals.....		266	250	182	164	862	300	249	197	135	881

Of the 42 institutions, two replied that no students were enrolled in mining. Statistics for the other 40 are presented in Tables I, II, III, and IV. In Table I statistics for the 40 institutions are arranged in groups according to the degree of completeness of the statistics submitted. References to these groups are made in the consolidated statistics appearing in Tables II, III, and IV. The institution numbers appearing in the tables, it should be noted, bear no relation to the order of the institutions in the accompanying list. A brief summary of the study was presented last month at the annual meeting of the American Institute of Mining and Metallurgical Engineers.

Inspection of the statistics presented in the four tables indicates:

1. For the two years preceding the current academic year enrollment decreased steadily.
2. The apparent slight excess in enrollment for the year 1928-29, as compared with 1927-28, may be attributed to an increase in the number of freshmen.
3. For 39 of the 40 institutions the number of seniors now enrolled is 209.

Whether a total of slightly more than 200 graduates

next June will meet the needs of the industry, and whether mining is attracting the youth of today in sufficient numbers to supply adequately the demand in the next few years for mining graduates—such questions are, perhaps, not readily answerable. Comments made by authorities at several institutions in their letters accompanying the statistics furnished for this study were to the effect that a marked demand prevailed for mining graduates, and that an increase in the number of mining students is expected. About an equal number of other authorities were not so optimistic. The situation would appear to warrant the consideration of both the mining industry and the educational institutions if the industry's needs are to be adequately met and the youth of the country properly acquainted with the scope and potentialities of the mining industry.

Favorable Conditions for Development of Non-metallic Industries in Pacific Northwest Revealed by U. S. Bureau of Mines Study

CONDITIONS would seem to be quite favorable at present for the building up of prosperous non-metallic mineral industries in the Pacific Northwest region, according to results obtained in a special study of non-metallic raw materials of this region that has been conducted by the Northwest experiment station of the U. S. Bureau of Mines, in co-operation with the University of Washington, Seattle, Wash.

Clay Articles Produced

The value of clay products manufactured annually in the states of Washington, Oregon, and Idaho is now passing the million-dollar mark, says the Bureau. These products are practically all structural wares, such as brick, tile, sewer pipe, and architectural terra cotta. The only pottery wares are red flowerpots from several small plants, some stoneware from Portland, and a few faience tile. No white pottery is being made at present.

The annual consumption of white wares in the three states named is estimated as follows:

White earthenware	$931,000
Sanitary ware	535,000
Electrical porcelain	490,000
Chinaware	276,000
Art pottery	22,600
Hardware pottery	3,800
Total	$2,258,400

These figures do not include the consumption of foreign wares, and hence do not represent the present true totals.

In contrast to conditions in other sections, where the various raw materials required for the manufacture of pottery must be collected from widely scattered places, it is possible for a pottery in the North Pacific area to acquire its own deposits of these essential raw materials and do its own mining and preparation. It thus will be able to secure a better uniformity and selection of materials at a lower cost. In some cases the purification or grinding equipment can be installed in the pottery plant, duplication of machinery can be avoided, and a shortening of the process can be established.

Plastic kaolins are found in large quantities in Washington, near Spokane, and in Idaho, near Troy, and Moscow. Feldspar is found near Troy, Idaho, and at Deer Harbor, Wash. Tests on the quality, methods of purification and preparation of these materials for the market have been made by the Bureau of Mines, in co-operation with the University of Washington, and indicate that kaolin firebrick, earthenware pottery, vitrified pottery, and some electrical insulators can be made from these materials.

The kaolin deposits are being used for firebrick alone at the present time. One company was encouraged to start a washing treatment of a very sandy and variable deposit of kaolin and is now making an all-kaolin firebrick and a superior type of refractory, plastic fireclay.

Kaolin Has Possibilities as Paper Filler

The kaolin, likewise, has possibilities as a paper filler for the numerous paper companies in the Northwest, and the white mica washed from the kaolin can be used as a filler in the prepared-tar roofing materials, like the mica from the North Carolina kaolins. The quartz from the kaolin after tabling can be used for glass sand and as the third ingredient in the pottery bodies.

The Pacific Northwest offers coal from Washington mines, has cheap hydro-electric power, and cheap lumber for packing, with a mild climate for all-year manufacturing. These facts, in addition to those already discussed, lead to the conclusion that the region now offers a favorable opportunity for the development of the non-metallic mineral industries.

Effect of Copper Minerals in Cyanidation

Certain copper minerals adversely affect the cyanidation of precious metal ores, but in a few operations ores containing minor perentages of copper have been successfully handled by cyanidation for the recovery of precious metals. The rare and precious metals experiment station of the U. S. Bureau of Mines at Reno, Nev., gives the following amount of dissolution of pure copper minerals under the usual conditions for cyanidation: azurite, 96.8 per cent; bornite, 94.0 per cent; chalcocite, 99.6 per cent; chalcopyrite, 8.15 per cent; cuprite, 99.2 per cent; enargite, 98.9 per cent, malachite, 99.4 per cent; tetrahedrite, 40.3 per cent; and chrysocolla, 16.9 per cent. Finely divided metallic copper is entirely soluble.

Air Receiver Explosions—Their Cause and How to Avoid Them

By Letson Balliet
Mining Engineer, Reno, Nev.

I HAVE HAD THE PRIVILEGE of investigating a number of air receiver explosions, where compressed-air tools have been employed. Several times I have reached the scene of the explosion within a few minutes after the accident. In one case the receiver was torn to fragments of various sizes and 300 ft. of 6-in. wrought-iron pipe, extending down a mine shaft, was ripped open. On other occasions the receiver alone was blown up. In all receiver explosions that I have examined in thirty years, the pieces were twisted and ruptured exactly as if several pounds of dynamite or some other high explosive had been set off on the inside of the receiver—not as if the explosive had been placed on the outside. The rupture was produced by an inside force.

Every instance within my observation has occurred upon receivers equipped with safety valves, and with unloaders on the compressor. Almost, if not all, reports that I have seen printed have laid the blame upon the poor old "safety valve" which "failed to function." This was an alibi. Actually it was not the fault of the safety valve.

Definitely and positively, I want to state right here that if the receiver had had a hundred safety valves, all in good working order and installed in the usual manner, not one of the accidents would have resulted differently. If the reader does not agree, let him put 25 lb. of dynamite inside an air receiver, pump the air up to 100 lb. pressure inside, and then set off the dynamite and see if the safety valve will save it.

Of course, no dynamite has been inside the shell of the receivers that have exploded. Something just as dangerous and as explosive has been there, however. An explosive mixture of hydrocarbon gases and air has been present in every instance just prior to the explosion. The reaction that has taken place has been identically the same as that which occurs when gasoline vapor, mixed with air through the carbureter, is put into the cylinder of an automobile and compressed. It is an explosive mixture of hydrogen, carbon, and oxygen in the air, which can be ignited by a spark. Gas companies have explosions, gas ovens have explosions, and any combustible gas, when mixed with its correct proportion of oxygen or air, becomes an explosive mixture, ready to ignite when the spark is applied. I have no doubt that thousands of explosive mixtures have accumulated in air receivers that have not exploded because the spark did not arrive.

Air receiver explosions may be prevented in two ways: either by preventing the accumulation of explosive mixtures in the receiver or by preventing the arrival of the spark, or by both.

Where does the explosive gas come from? The reader should remember that the air compressor is the exact reversal of the steam engine; that it takes its air from the atmosphere, compresses it, and discharges it into the "boiler shell" under pressure, whereas the steam engine takes its supply from the boiler under pressure, lets it expand, and discharges it to atmosphere. He should realize also that most compressor operators think of lubricating oils in connection with compressors in the same terms as in connection with steam engines. The compressor does not have the scouring action of steam, nor does it need as much oil as a steam cylinder, and, moreover, if a steam cylinder is fed with an excess of oil, the gases and oil vapors are discharged into the air, and not into a closed receiver.

Although gas analyses drawn from the top of air receivers, after standing for half an hour under pressure with the compressor stopped, will often show only a trace of CH_4 and C_nH_n[2] and occasionally C_6H_{14} and H, this is enough to indicate that they might occur in greater quantities in any receiver. Often I have found considerably more than a trace, and the amount might be still further increased at times. Obviously, I have never been able to collect any gases after an explosion, nor has any explosion that I am familiar with occurred immediately after drawing a sample.

I must therefore theorize that the volume of explosive gas which I know is present at times may at other times be greater than I have found it to be. Coupling this with the fact that examination after the explosions has shown a definite effect such as would result from explosive action, and not merely from a pressure rip or tear, we must accept the evidence as indicative of a true explosion, and not merely of an instance of a pressure relief.

A physical property of lubricating oil is its flash point. The test to determine it is made at atmospheric pressure, and not at 100 lb. pressure. The physical geography of our early days taught us that a candle burned dimly on a high mountain and brightly in a caisson under pressure.

In the course of our studies of elementary chemistry we place a paraffine (hydrocarbon) candle under a bell jar, where it burned dimly as we exhausted the air, and brightly as we increased the pressure. When supplied with pure oxygen instead of air, it burned still more rapidly. We may properly ask what would be the flash point of lubricating oil under pressure, under the increased heat of compression, when vaporized, or atomized, and when some volatile gases have been driven into the air at several atmospheres' pressure.

In liquid oxygen explosions, the explosive consisting of lampblack (carbon) and liquid oxygen, we have almost instantaneous combustion, which we call an explosion. The lubricating oil, when burned in the open, produces smoke. Obviously, carbon is present.

In all air receiver explosions, I have found the bottom

plates thickly coated with heavy oil and dust, this being a viscous mass. The top plates have been dry and clean. They have probably burned clean. In spite of this evidence we know that if a piece of white cloth is sprayed with ordinary compressed air as used for air tools, at a distance not too remote from the compressor, it becomes dirty and will show a grease spot from atomized oil contained in the air.

Almost undeniably, the evidence points to combustible

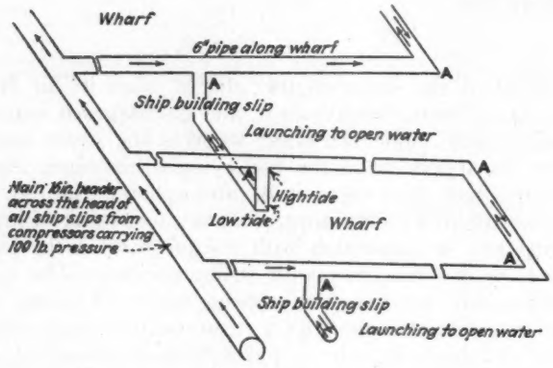


Fig. 1—A perspective sketch of an improperly designed air line which permitted moisture to collect

mixtures of hydrocarbon gases from the lubricating oil as the cause of the explosions.

I have made laboratory tests (not in practice), trying to lubricate the compressor cylinder with soapsuds, emulsifying liquids, animal oils, and vegetable oils. Possibly this might be the remedy. The large quantity of soapsuds and of some other lighter liquids required would in itself be no insurmountable obstacle—the drain traps could be arranged to care for that. In some places, aftercooling, precipitation of moisture and reheating of the air are practiced, but this is seldom so around mines, quarries, and construction jobs. In liquid air and compressed gas plants, and in some refrigerating processes, expansion and contraction by cooling and reheating is an important step and may be more generally used with further progress. Hence, moisture drainage does not appear to be a difficult problem.

The Problem of Getting Rid of Moisture

Moisture will give difficulty if not properly taken care of. In one of the shipyards, in strenuous operation during the war, I found a compressed-air pipe line built as shown in Fig. 1. Each slip and each wharf with a 6-in. pipe line the full length of it was cross-connected, as indicated by the double arrows, making a "loop" for the air to pass either way from the header line, depending upon which side of the loop drew the most air. Manifolds and hose connections for air tools were taken off the 6-in. lines along the sides of the wharfs and slips. No hose connections were possible on the connection lines indicated with double arrows between the points *A*. Every possible connection had been made all over the plant to have air coming from two ways, or around these "loops," which were mere moisture gatherers and water pockets, costing the plant thousands of dollars per hour. The capacity of the 6-in. lines was ample. Therefore, there was no reason for cross-connections, which made water pockets that could not be drained. Some of the connections were below water level except at extreme low tide. Ships when launched passed over the pipe connections in the slips. On foggy days, when the compressors were pumping eight tons of water an hour into the air lines, the water would gather in the loops to such an extent that it would put out the coke rivet-heating fires.

Every morning 5,000 workmen would stand idle until 9 or 10 o'clock "blowing water from the mains through the hose." The riveters would remove their tools and the heater boys would disconnect their hose from the tuyères and stand by the hour atomizing the water from the water pockets in the mains.

Blowing insecticide liquids with a tin tube, or a spray gun, or a perfumery atomizer, draws the liquid into the stream of air across the spraying tube in the same way that compressed air atomizes water in a loop. One cannot drain a circular receptacle full of water without atomizing it. A loop is a circle in its effect. If the air is admitted into the loop, as shown in Fig. 2, it takes the easiest way to the outlet, but puts identically the same pressure on the water in the loop, holding it level with the outlet where the stream of air passing takes it out a little at a time. The water is atomized out and sprayed, instead of being forced out.

The traps or water pockets in Fig. 1 were never completely emptied. Often the header and the lateral pipe lines were half full of water, forcing the air to pass over the water in the upper half of the pipe, gathering moisture all the way.

To remedy this, I cut the loops out at the points *A* in Fig. 1 and placed a positive drain trap at the end of each lateral. In two minutes the pipe lines could be

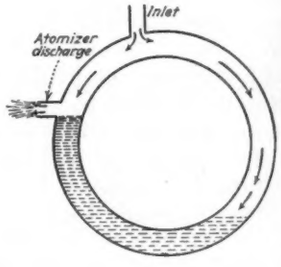


Fig. 2—Sketch illustrating how water may be atomized from a loop, being pressed upward to the point of discharge

drained by opening the drain valve. With wages at from 60c. to 80c. per hour for the rivet gangs and the air tool users, and the plant overhead added, the saving was $1 per hour for 5,000 men, or $5,000 an hour for two to three hours every foggy morning.

A horizontal pipe laid in a trench or along a wharf, or through a tunnel or drift, if improperly drained, can become partly filled with water. If this happens, the pipe is reduced to half capacity by the water occupying the bottom semicircular trough of the pipe, and the air must pass over the water throughout its length in the open area above the water.

In Fig. 3 is shown an air receiver in the shipyard which was installed in a 6-in. air line 1,000 ft. or more from the compressor. It served no purpose save to act as a drain trap. It was crushed by one of the cranes dropping a heavy casting on it. There was much noise from the escaping air, but no explosion, no combustion, and no smoke. The inside of the shell plates would have soiled a white cloth with dust, dirt, a little oil perhaps, and with rust.

This receiver, which was really a drain trap, had never given evidence of the presence of any combustible gases, and I am sure the presence of more than a trace could

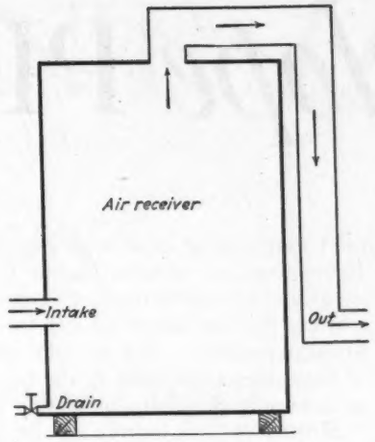


Fig. 3—An air receiver which served only as a moisture trap

not have been shown at any time. It was too far away to get a "spark" of carbon from the compressor, and so was never in danger of exploding. It was never replaced in the line. A drain trap with a float valve was installed in its stead.

A Safe Receiver

In Fig. 4 I have indicated a design of what I believe will be a perfectly safe receiver, one that will be free from explosions. This receiver should be located some distance from the compressor, far enough so that a direct spark cannot very readily be blown into it. By setting the safety valve ahead of the unloader, it will "pop" occasionally, but as that may be too often to please the operator, it can be manually operated at intervals.

The logical time to look for an air receiver explosion, if one were going to take place, would be just after the compressor is started up after a short shutdown. While idle, a little excess oil may have drained into the cylinders

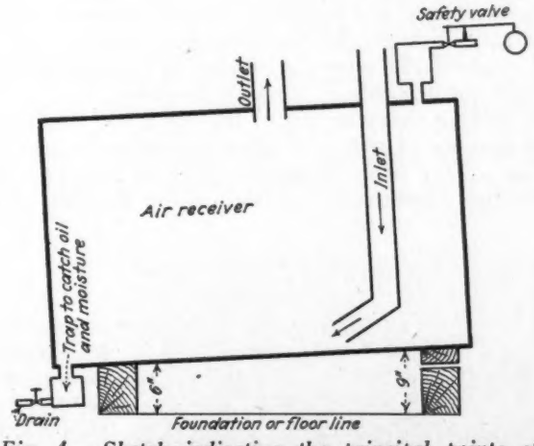


Fig. 4—Sketch indicating the principal points of design and arrangement of an air receiver that should be safe from explosions

from lubricating pipes. This is heated, vaporized, partly volatilized, and punched into the receiver, perhaps above the temperature of ignition, which is followed by an explosion. In starting the compressor at such a time, a cord pull upon the safety valve will (perhaps) liberate some of the hydrocarbon gases if any have collected. It will not make it any worse, at least.

If the compressor could exhaust a half minute to the atmosphere after a short shutdown, on the theory of getting rid of any possible oil accumulation before turning it into the receivers, that operation would be a further aid to safety.

The inlet from the compressor is shown discharging toward the oil and moisture drain. This arrangement helps to scour the bottom of the compressor and thus keeps it free from liquid oil and moisture. A drain pocket is essential, as the moisture and oil drain into the trap at all pressures and at all times, whereas a simple valve in the bottom of the compressor will allow the air to punch a hole through the viscous and liquid matter without draining it quickly. In time, the valve would drain this liquid by atomizing it from the edge of the hole, but when the oil becomes viscous from dust, it needs the assistance of the intake discharge to blow it toward the trap and drain.

Mining Laws of Rumania and Czechoslovakia

A PAPER on the mining laws of Rumania has been prepared by John W. Frey, associate mineral economist of the U. S. Bureau of Mines. It presents one of a series of digests of foreign mining legislation and court decisions which is being prepared in advance of a general report relative to the rights of American citizens to explore for minerals and to own and operate mines in various foreign countries. This interpretation of the laws of Rumania, originally prepared from the best available information in Washington, has been checked through the courtesy of the Department of State, by the American Chargé d'Affairs at Bucharest (Oct. 19, 1928).

The mining law promulgated by royal decree (No. 2294) under date of July 3, 1924, asserts the claims of the state to ownership of practically all commercial minerals (Articles 1 and 2) and provides that these minerals shall be conserved for exploitation largely by Rumanian capital.

The ownership of all mining companies formed after July 3, 1924, must be at least 60 per cent Rumanian, and the chairman and at least two-thirds of the members of the board of directors must be Rumanian (Article 33).

Companies with foreign capital in existence prior to July 3, 1924, but which do not fulfill all the conditions of Article 33, may obtain land from the state if they will make a declaration that within the first ten years they will adapt themselves to Article 33 and modify their board of directors so that two-thirds of the directors and the chairman will be Rumanian. For such companies the requirements as to Rumanian capital are reduced to 55 per cent.

Companies existent before July 3, 1924, which then had a simple majority of the capital (51 per cent) held by Rumania and a majority of Rumanians on the board, may secure mining concessions from the state if they have 51 per cent of the capital in the hands of Rumanians. (Addition to Article 32 of the Mining Law, 1924, published in "Monitor Official" No. 270. Dec. 6, 1925).

A similar circular devoted to the mining laws of Czechoslovakia has also been prepared by Mr. Frey and may be obtained on request from the Bureau of Mines for Circular 6,103. This country has very liberal regulations and makes no distinction between citizens of Czechoslovakia and foreigners, reciprocity being supposed.

Roan Antelope PILOT

By WALTER C. PAGE

Metallurgical Engineer in Charge of Pilot Plant and Concentration, Roan Antelope Copper Mines, Ltd.

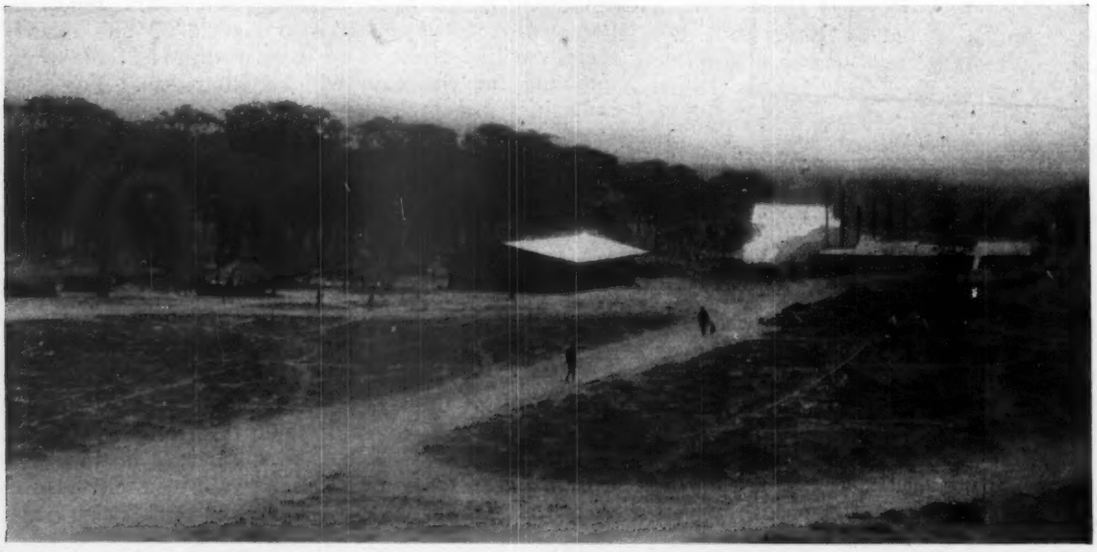
AFTER operating its 25-ton pilot plant continuously for eleven months, during which time ore from fourteen different working places has been tested thoroughly, the Roan Antelope Copper Mines, Ltd., is assured that the large tonnage of ore thus far developed, which is represented by the quantity tested, is amenable to treatment by the same process, with respect to grinding and reagents, as that worked out in the pilot plant. Results obtained in the latter are, of course, not to be regarded as insusceptible of improvement in the larger plant. The objective of the pilot plant work was not to achieve the ultimate at the outset, but rather to develop a simple scheme which would give good results in the pilot mill and be capable of duplication in a large plant. Refinement of process, higher recoveries, improvement in grade of concentrate, and best economy are rather matters that can better be left for working out in a plant of large capacity. For all that, the recoveries and grade of concentrate obtained in the pilot work were excellent, as accompanying data indicate.

Much has been written of the Roan Antelope ore and its mode of occurrence. Inasmuch as this short article will be limited to a discussion of the results of the pilot work, suffice it to say that the ore is a partially silicified shale, averaging 3.25 to 3.5 per cent copper, in which the copper occurs principally as chalcocite, with varying amounts of bornite. The copper minerals are finely disseminated throughout the shale—so much so that the appearance of the ore is quite misleading. This is evidenced by the fact that when the first borehole was put down by the company, it passed entirely through the ore formation, and the latter was not detected until core assays were available. The chalcocite and bornite apparently follow the bedding planes. A complete analysis of the ore disclosed in one of the boreholes is as follows:

Per Cent		Per Cent	
Cu	3.6	Al_2O_3	28.4
Insol.	72.0	$CaCO_3$	3.91
SiO_2	51.9	$MgCO_3$	2.38
Fe_2O_3	4.6	S	0.9

Some sodium and potassium are also present, probably as alkali silicates. In the foregoing analysis the lime and magnesia have been calculated to carbonates. They are present probably as silicates, however.

A striking characteristic of the ore is the almost complete absence of pyrite or other non-copper-bearing sulphides. Very little, if any, of these is present. As a result the concentration of the ore by flotation is ren-



Looking along Roan Antelope lode toward pilot plant and No. 2 shaft from No. 3 shaft. Site proposed for concentrator is, approximately, the open ground at right.

PLANT *Test Work Gives Excellent Results*

dered extremely simple as regards obtaining a high-grade copper concentrate, and involves no selective action between different sulphide minerals. Owing to the shaly character of the ore, considerable colloidal slime is produced in grinding, which, if not inhibited, does interfere in the subsequent flotation work and demands careful selectivity between gangue and sulphides.

Operation of the pilot plant prior to June 1, 1928, was preliminary in character, serving to determine the basic characteristics of the ore and the reagents to be used. From June 1 on, however, the plant was operated continuously, as if it were in production, running on ore from fourteen different working places in succession, as previously stated. These included every representative working face which was opened in the mine prior to or during the period of pilot plant operation. Ore was taken from different faces in shafts Nos. 1, 2, 3, 5, 9 and 10 (2 and 3 are shown on map on p. 522), these being the shafts, inclined and vertical, from which representative ore was available. Openings Nos. 4, 6, 7, and 8 were shallow pits or shafts. On the ore from each working place, which in most cases was the ore produced from the various crosscuts, the pilot plant would run for one to two weeks, after which it would continue on ore from a different working, without break in operation and with practically the same reagents as had been determined upon in the period of preliminary operation prior to June 1. Complete and detailed data covering the results obtained on every shift from June 1 to Oct. 20 inclusive afforded the basis for the final report made on the concentration work.

The pilot plant flow sheet is shown in the accompanying illustration. Inasmuch as it is self-explanatory, the equipment involved calls for little comment.

Approximately 94 to 98 per cent minus 150-mesh was the grinding practice followed during the period of representative operation. This appeared to be the critical point of grinding necessary to liberate the sulphide minerals when using the classifying equipment with which the plant was equipped. This is shown by the fact that the screen analyses of the tailing gave assays of approximately 0.75 per cent copper on plus 150-mesh material, whereas the minus 150-mesh material assayed approximately 0.18 per cent copper. With the use of bowl classifiers and with more efficient and flexible classifier operation in the large plant to be erected, it will probably be possible to practice somewhat coarser grinding with equally good recovery.

The fact that the ore has an average and uniform specific gravity of 2.8 should permit very clean classification and liberation of the sulphides with the use of bowl classifiers. This is on account of the wide variation in the specific gravity of the sulphide minerals and the shale gangue minerals.

View along lode from headframe at No. 2 shaft, looking toward No. 3 shaft. Note absence of forest growth along outcrop. The site selected for the new concentrator is beyond the building at the right, on the footwall of the lode.

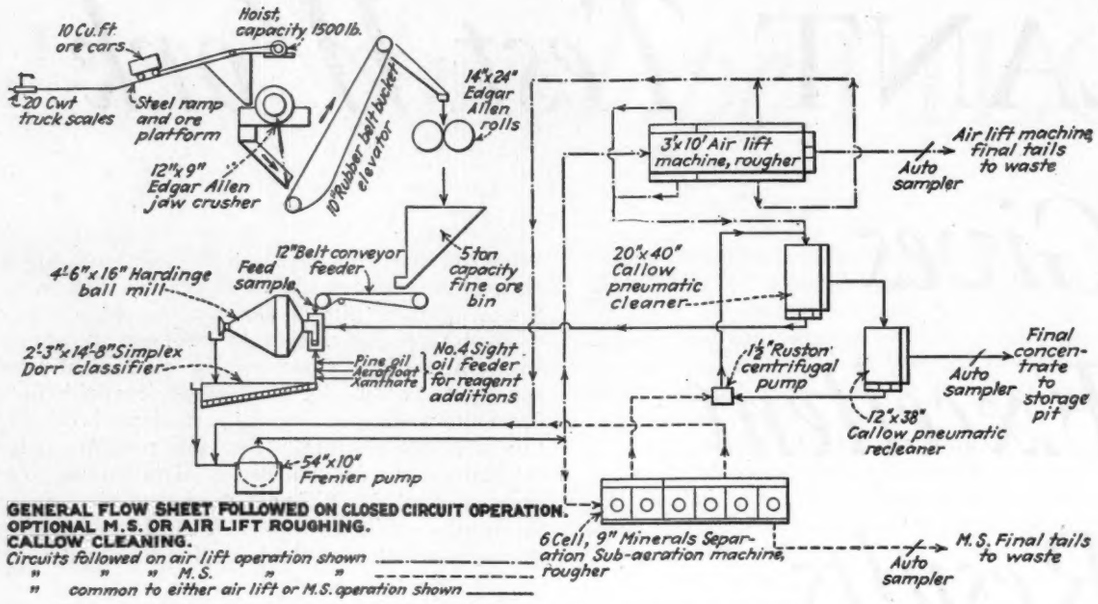

10 Cu.ft ore cars
Hoist, capacity 1500 lb.
20 Cwt truck scales
Steel ramp and ore platform
12"x9" Edgar Allen jaw crusher
10" Rubber belt bucket elevator
14"x24" Edgar Allen rolls
3'x10' Air lift machine, rougher
Air lift machine, final tails to waste
Auto sampler
20"x40" Callow pneumatic cleaner
12" Belt conveyor Feed sample
Feeder
5 ton capacity fine ore bin
4'6"x16" Hardinge ball mill
2'-3"x14'-8" Simplex Dorr classifier
Pine oil Aerofloat Xanthate
No. 4 Sight oil Feeder for reagent additions
1½" Ruston centrifugal pump
Final concentrate to storage pit
12"x38" Callow pneumatic recleaner
54"x10" Frenier pump
GENERAL FLOW SHEET FOLLOWED ON CLOSED CIRCUIT OPERATION.
OPTIONAL M.S. OR AIR LIFT ROUGHING.
CALLOW CLEANING.
Circuits followed on air lift operation shown
" " " M.S. " "
" common to either air lift or M.S. operation shown
6 Cell, 9" Minerals Separation Sub-aeration machine, rougher
M.S. Final tails to waste

Fig. 1—Flow sheet of the Roan Antelope pilot plant

Classifier overflow was maintained at approximately 25 per cent solids throughout the period of operation, whereas the tailing showed approximately 22 per cent solids, owing to dilution by the return of intermediate middling products.

Temperature of the mill-feed water varied, naturally, from 80 to 90 deg. F. The region in which the Roan Antelope mine is situated is 13 deg. south of the equator and at 4,000-ft. elevation.

The interference experienced from colloidal slime produced in grinding the shaly ore, previously referred to, was overcome more through the adoption of preventive measures against their inherent propensity to form on a large scale in the grinding and classifying circuits, or against their building up in the flotation circuits, rather than through the use of any corrective reagents. Much less trouble will probably be experienced from slime in the future plant, because of the use of more efficient and more suitable grinding and classifying equipment.

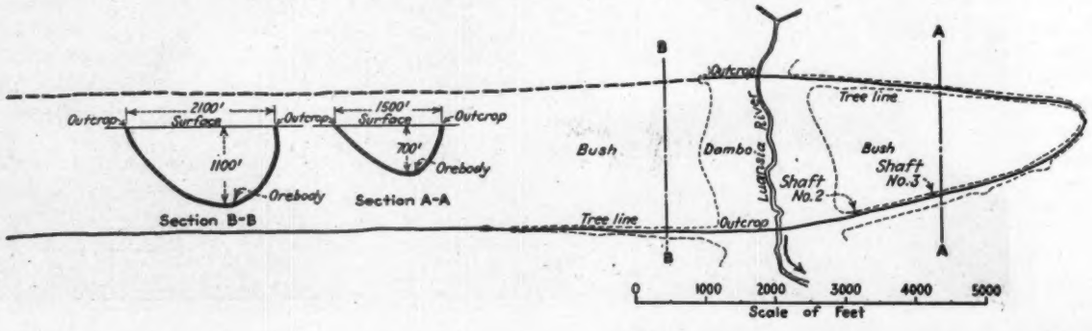
The reagents used in the flotation department were in general Aërofloat, potassium xanthate, and steam-distilled pine oil and cresylic acid. These were used in varying combination throughout the test work. The combination most often used was Aërofloat and pine oil. Consumption of reagents was unique in that it was extremely low, considering the grade of ore, fineness of grinding, and the shaly character of the ore, with the resultant production of colloidal slime.

The consumption of the Aërofloat-pine oil combination was roughly 0.03 lb. Aërofloat per ton of feed and 0.04 lb. pine oil per ton of feed. Approximately 0.02 lb. cresylic acid per ton of feed was used as a diluent for the Aërofloat to permit more uniform and satisfactory feeding of this concentrated reagent.

Addition of such very small amounts of reagents called for the devising of special means. It was accomplished by the use of sight-feed oilers, or drip cups. Reagents were fed ordinarily at a rate of 4 to 20 drops per minute. This was the range made possible by the use of sight-feed oilers. This method of feeding proved entirely satisfactory, although calling for close inspection. The problem of discovering how to feed such small amounts of reagents required in a plant of such limited capacity gave some difficulty at first. However, I had previously used drip cups for this purpose in the test plant of the International Smelting Company at Tooele, Utah, on lead-zinc work. The cost of reagents delivered at the present time at the Roan Antelope property is roughly 50 per cent more than in the Western states.

Use of lime was found neither beneficial nor detrimental within reasonable amounts; that is, the presence of lime had little, if any, effect on grade of concentrate or recovery. Addition of lime was not found necessary, because of the basic characteristic of the ore and because both the mine water that was used in the pilot plant operation, as well as the water from the local rivers, was slightly alkaline. In the large plant we expect to use lime to facilitate settlement of the tailing for re-

Fig. 2—Sketch (reproduced from "E. & M. J." of Sept. 15, 1928) showing outcrops and approximate sections of lode. Position of shafts Nos. 2 and 3 is roughly indicated.



A near view of the Roan Antelope pilot plant. The new concentrator is to be erected in this vicinity on the footwall of the lode.

covering water. In view of what has been stated, the reader will see that any lime returning to the mill in reclaimed water will do no harm in the flotation circuit.

Owing to the lack of other than copper-bearing sulphides in the ore, an excellent grade of concentrate and a remarkably high recovery were obtained. This will be seen by inspecting the data given in the following representative tables of pilot plant operation on four different lots of ore from as many working places.

Results obtained from a continuous run of 14 shifts on crosscut ore from No. 3 shaft, at 420 ft. vertical depth, were as follows:

	Per Cent
Feed, Cu	3.52
Tailing, Cu	0.22
Concentrate, Cu	50.05
Concentrate, Fe	3.49
Concentrate, insoluble	27.9
Concentrate, S	13.45
Calculated recovery	94.10

A run of 23 shifts on ore from a different crosscut in No. 3 shaft gave the following results:

	Per Cent
Feed, Cu	3.41
Tailing, Cu	0.207
Concentrate, Cu	55.26
Concentrate, Fe	3.49
Concentrate, insoluble	20.4
Concentrate, S	15.17
Calculated recovery	94.26

A run of 20 shifts on ore from No. 10 shaft gave comparable results:

	Per Cent
Feed, Cu	3.39
Tailing, Cu	0.255
Concentrate, Cu	51.08
Concentrate, Fe	3.69
Concentrate, insoluble	25.03
Concentrate, S	14.89
Calculated recovery	92.94

A run of 47 shifts on ore from No. 2 shaft gave the following results:

	Per Cent
Feed, Cu	3.71
Tailing, Cu	0.207
Concentrate, Cu	49.01
Concentrate, Fe	4.63
Concentrate, insoluble	27.46
Concentrate, S	15.13
Calculated recovery	94.32

The average results of twelve shifts taken from ten days' operation on ore from No. 9 shaft is as follows: Concentrate, 64 per cent Cu, 4 per cent Fe, 10 per cent insoluble, 18 per cent S. Tailing, 0.15 per cent Cu. These data are given merely to show what it is possible to do on this ore when the conditions more nearly approach the ideal, as they did in this operation. This particular ore apparently was more highly silicified, a condition which resulted in a correspondingly smaller production of slime.

Screen analysis of the flotation concentrate showed it to be 96 to 98 per cent minus 200 mesh. The concentrate settled very quickly and was easily filtered.

It will be appreciated that it was almost impossible to maintain steady and satisfactory cleaning and re-cleaning operations in a plant of such small capacity and on such a high ratio of concentration giving such a relatively small quantity of concentrate to re-treat. This condition naturally will not exist in the future economic operation, and concentrate averaging from 55 to 65 per cent copper may not unreasonably be anticipated, with eventual recoveries that will be at least equal to those obtained.

I was ably assisted in this pilot plant work by B. A. Corkill, formerly on the staff of Minerals Separation, Ltd., and also Union Minière, and by James Douglas, formerly of Douglas, Ariz.

In conclusion, it may be said that equally good results were obtained from the use of Minerals Separation and air-lift type machines shown in the flow sheet when operating consecutively on ore from the same respective working places.

BY THE WAY

The Stock Tipster's Latest Game

IN A CIRCULAR recently issued by The Better Business Bureau of New York City, entitled "Stamping Out the 'Tipster Sheets,'" it is stated that the backbone of the "tipster sheet" system of stock swindling, which reached its peak early in 1928, has been broken. George Graham Rice has been convicted, and governmental investigation has been directed toward Charles Beadon and Maurice Singer, an indictment being secured against Beadon and a restraining order against Singer. Beadon has been the publisher of the *Stock Market Reporter*, and formerly published *Trend of the Market*. "Named in the federal indictment with Charles Beadon were Michael Barnett, president of the Utah Lead Corporation; Harry Phillips, broker, at 25 Broad St., New York City; William Rankin, broker and member of the Salt Lake City Stock Exchange; Joseph Morris, a chief henchman of Beadon's; and W. P. Gibson and John Ellis, of New York City." In addition to Utah Lead, Inc., Beadon is said to have promoted Rubec Mines, Ltd., and Simard United Mines, Ltd., Canadian ventures.

"Singer," says the Bureau, "was not as sensational in his stock-selling methods as were George Graham Rice and Charles Beadon, yet he has succeeded by 'tipster sheet' methods in selling at unconscionable prices large amounts of stock which now have little or no market value." He had an interest in *The Wall Street Outlook, The Wall Streeter, Pratt's Stock Trend*, The Kurtz System, Securities Stock Company, Ltd., National Forecast Service, National Bureau of Financial Information, American Mailing Service, Municipal and Industrial Securities Company, and Lionel Investors' Service.

"The versatile 'blue-sky' operator, however, is no sooner off with the old than he is on with the new. Many of his ilk have turned to another system which they believe is within the law. It is a simple process and profitable—if it works. Adopting a high-sounding 'advisory service' title, or other disarming name, the vendor sends to his old lists of credulous speculators recommendations to purchase a certain listed stock—one dealt in on a reputable stock exchange. His letters and literature are dignified; his language is conservative. The success of his effort depends upon the number of people who blindly follow his tips.

"Before sending out his recommendations, the operator obtains an option on or secures a position in a large block of the stock he recommends—a security having small distribution. When the market price goes up, as usually happens from the concerted buying that results from his tip, the operator unloads. When the artificial stimulus of his 'advice' is withdrawn, the price of the stock falls to a level governed by the normal law of supply and demand, and often the operator makes money selling it on the way down. In his messages to his credulous followers he then points to his alleged success in predicting the rise and he launches another suggestion and repeats the process. He is silent as to the price to which the security receded, and the speculator who follows the suggestion usually blames himself for not having taken his profit when the price was up.

"In this form of operation the 'tipster' handles no money. He instructs his following to purchase the stock through their own brokers. His profits are made by his purchase and sale in the market of the security he recommends. Operations of this nature, therefore, are difficult to halt by legal means. He who is tempted to heed such 'tips' can protect himself only by forming the habit of investigating before buying."

Speed and Other Things in Their Highest Refinements

ACCURACY is all right in its place, but the statement that Major Segrave, in setting a new world's record for speeding over the surface of the earth the other day, drove his automobile at a speed of 231.36246 miles per hour drew at least one smile from those who read it. It seems that his speed was measured electrically, by the car touching a wire at the start and finish of the race, and was recorded to the hundredth of a second. The first run of the race was timed at 15.15 seconds, which the highly theoretical mathematicians figured out was equivalent to 231.51125 miles per hour; the second run, in the other direction, was accomplished in 15.57 seconds, or at the rate of 231.21387 miles per hour. The average, it is said in the report before us, is thus 15.56 seconds, or 231.36246 miles per hour. As a matter of fact, some one slipped up in his calculations, for the average should be 231.36256, as any school boy could easily determine. Not that it matters, however. As the time is calculated only to the hundredth of a second, it is obvious that to carry the speed out beyond the first decimal place is meaningless and ridiculous. One is reminded of the meticulous assayer who finds that the analysis of one sample of a lot of copper ore is 2.456 per cent, and of another sample of the same lot, 2.388, whereupon he reports that the ore must contain 2.422 per cent of copper. Company reports are not blameless in this respect either. Without too much search, we note that the Noranda smelter last year "treated 271,926.1 tons of ore, flux, and concentrates"; that the Independence mill out in Colorado treated 134,054.31 tons; and that the Engels Copper Mining Company has 409,341 tons of ore blocked out, and 36,816 tons of "probable ore." Thus do we reach up to the heights of the meticulous and pull down the ultimate in accuracy.

Whence Came King Solomon's Gold?

THE source of the gold that King Solomon acquired through the kind offices of the Queen of Sheba has long been the subject of much conjecture and study—so much so that two schools of thought holding widely divergent views have been formed. One, the Rhodesian school of belief, contends that Southern Rhodesia and Manicaland, with their many ancient workings, supplied the yellow metal for the exchequer of King Solomon's regime, and that what is today known as Rhodesia was the Ophir of the Bible. The other group, which for want of a better name may be termed the medievalists, holds that these ancient workings date from the Middle Ages, when Spain was seeking mineral wealth in the New World and the Portuguese were exploiting Africa and the East, and that these excavations could not therefore have provided the gold in question.

Writing in the March number of the *Compressed Air Magazine*, Owen Letcher, editor of *Mining and Industrial Magazine of Southern Africa*, and who is well versed in early African history, presents another theory on the subject as follows: "If we are to accept the belief that the Ophir of the Bible was not in Rhodesia at all, one may pertinently inquire, 'Where, then, was this land of fabled wealth?' A new line of thought and an avenue worthy of research is suggested by the idea that Ophir was situated in the region of the Kilo-Moto gold fields in the northeastern section of the Belgian Congo. I now put forward the theory that this remote auriferous region may have been the source of the precious metal which enriched King Solomon; and I suggest that the access to this area via Lower Egypt and the Nile may be worthy of special consideration in seeking to solve a problem which has proved such a bone of contention for many centuries amongst archeologists and historians, explorers, and gold seekers."

But as T. A. Rickard points out in a letter to Mr. Letcher quoted in his article: "Where did all this gold go? By what nation, by whom, was it absorbed? Surely the production of such a large amount of the precious metal would have made its mark on history." "And if we get down to actual hard historical facts so far as they are ascertainable, it must be admitted," comments Mr. Letcher, "that there are no very reliable pages in ancient history stamped with the impress of all this gold that is alleged to have been produced in remote times." All of which

fosters the belief that King Solomon's gold will provide research material for archeologists, historians, and others for some time to come.

One Way to Make Money

MINING COMPANIES with plenty of cash on hand do not require any ore to make money these days. It is reported that International Nickel, for example, recently had $17,600,000 in the call money market. Much of this will eventually be required for mine development and mill, smelter, and refinery construction, but in the meantime, with money rates varying as they have recently between 8 and 20 per cent, a good income from this source alone is possible. This is not to insinuate that International Nickel has no ore.

What Kind of Animals Are These?

According to the *Canadian Mining Journal*, Dr. R. S. Caffery gave a talk at the Winnipeg meeting of the Canadian Institute recently on "Metallurgical Slugs." These must be the organisms responsible for high slag losses.

Consultation

Large Lots of Lead Chloride Wanted

"There is a possibility that a demand for 5,000 to 10,000 tons of lead chloride per year can be created. The conditions are two: first ,that I can duplicate on a tonnage scale what I have done on a laboratory scale; and, second, that lead chloride can be obtained at a price about 80 per cent of the market price of lead. In other words, if the price is based on the metallic lead content of the chloride, it promises to be an economical proposition. It occurs to me that lead chloride might be made as an intermediate product by smelters and sold on such a basis. I would appreciate very much if you could give me information as to the possibility of obtaining lead chloride under these conditions."

No such tonnage of lead chloride is now produced as an intermediate product of the reduction of lead ores, so far as we know, though the chloridizing roasting of lead ores, and subsequent precipitation of the fume by Cottrell equipment, has been tried at various times. If any of those interested in this work feel that they could operate successfully, marketing their product at four-fifths of the price of lead or thereabouts, as our inquirer suggests, we shall be glad to hear from them. The Western Metallurgical Company, of Humboldt, Ariz., has a process that might be adapted to this purpose, as has the Cerro de Pasco company, at its operations in Peru.

COMMENT AND CRITICISM

Additional Names for the Borderland Material Between Ore and Waste

To the Editor of "E.&M.J.":

I read in the *E.&M.J.* of March 16 an editorial entitled "Defining Borderland Material Between Ore and Waste." In this editorial you ask for suggestions of a name to best define the zone of ore between the orebody proper and the gangue. Why not call it "gangue-ore," which refers both to the ore and the gangue, meaning the mineralized gangue zone? JOHN LEWISOHN.

New York, N. Y.

To the Editor of "E.&M.J.":

I have been considerably interested in the several letters and in your editorial of last week on the subject of the best name for that product of every mine which is not ore of commercial grade but which under conceivable circumstances might ultimately come into this class, and with which every mine manager has to deal at some time or other.

Looking at the matter from a basic point of view, we recognize that rock which contains no mineralization is of necessity waste, but when we have a quantity of rock which contains, shall we say 0.75 per cent copper, can we put this down as something absolutely useless, especially in view of the vast improvements that have been made in extraction processes in the last few years?

How often does a manager look at the returns from the assay office, of the various faces of his mine, and have considerable difficulty in deciding whether some of the product is ore or waste? What is his reaction to this condition? He hates the necessity of making a decision, but has to do so, and as a rule he abhors the job.

I suggest that a suitable name for this undesirable product might with very good reasons be "Abore."

FRED J. BROWN.

Kirkland Lake, Ontario.

To the Editor of "E.&M.J.":

I have been following your discussions about material that contains metal and is not good enough to be classed as ore. A number of years ago I had a manganese claim before the War Minerals Relief Commission in Washington and the commission asked me to give my definition of ore. My definition was as follows: Ore is a mineral substance that can be mined, milled, and sold at a profit. This was considered a good definition by the commission, and my idea of so called near-ore would be to call it merely "mineral substance."

CARL J. TRAUERMAN.

Butte, Mont.

[The list continues to grow. Perhaps someone will have the temerity to suggest that one of the terms already mentioned impresses him favorably? In the meantime all comment is desirable, because it arouses additional information in an important subject.—EDITOR.]

Montana Still Lacks a Geological Survey

To the Editor of "E.&M.J.":

The twenty-first session of Montana's state legislature passes into history without establishing a state geological survey for the "Treasure State." The matter has been under consideration since the preceding session, and H.B. 293, as drafted, was based on the best legislation of the older states as applicable to the conditions in Montana. The sponsors of the movement are under deep obligation to the heads of departments of nearly every state in the Union which has an established survey for copies of the legislation, enacted by the respective states, and for timely suggestions and expressions of appreciation of Montana's great need of such a department.

The proposed law for the establishment of the "Montana State Bureau of Geology and Mineral Resources," H.B. 293, was sidetracked in the house committee on mines and mining for substitute H.B. 281, the sole object of which was to change the name of an existing but inoperative "Bureau of Mining and Metallurgy" (a research department attached to the State School of Mines) to "Montana State Bureau of Mining and Geology." The change was made by the committee solely as a "home-town" measure amending an act of 1919, but which, in no way authorizes a "geological survey," and without realizing the damage to the state at large by the suppression of the development of the vast and varied mineral resources of all parts of the state, which has lagged far behind that of the agricultural resources in recent years, owing to the activities of the Department of Agriculture, Labor and Industry.

Failure to pass H.B. 293 leaves the state without a source of reference on the mineral resources other than the meager information available in the Department of Agriculture, with no individual organization and without an appropriation for co-operation with the U. S. Geological Survey. It is especially unfortunate at this time of active inquiry for Western sources of petroleum, minerals, and metals. L. S. ROPES.

Helena, Mont.

[In Montana, as elsewhere, the development of mineral resources apparently lacks the support given by the electorate to agriculture. Larger families for mining men are indicated: more votes are needed.—EDITOR.]

Control Equipment of Electric Shovels Merits Careful Consideration

It Must Be Protected Against Dirt and Moisture, Readily Accessible for Proper Maintenance, and Compactly Arranged

By David Stoetzel
Industrial Engineering Department, General Electric Company

ON electric shovels using variable voltage (Ward Leonard) control, a considerable quantity of control equipment requires mounting in the shovel house. First comes the main motor-generator set. This may use either a squirrel-cage induction motor or a synchronous motor for the driving unit. This motor is usually designed for 440- or 550-volt operation on small shovels and for 2,200- or 4,000-volt operation for the larger machines. If the motor is of the squirrel-cage type, it is usually so designed that it may be thrown directly across the line for starting. If it is of the synchronous type, compensator starting must be used in the standard way for this type of machine.

Control equipment for all the miscellaneous auxiliary apparatus on the shovel is also necessary. This will include the dipper-trip motor; the motor for the ventilating blower on the main motors and generators (when used); the air compressor for operating brakes and clutches; the exciter set, including control for both the alternating-current driving motor and the direct-current output; solenoid brakes (when used); and auxiliary small power transformers. Although all these various parts of control equipment are small and simple when considered individually, as a group they present a rather formidable appearance, especially when the nature and conditions of the service are considered.

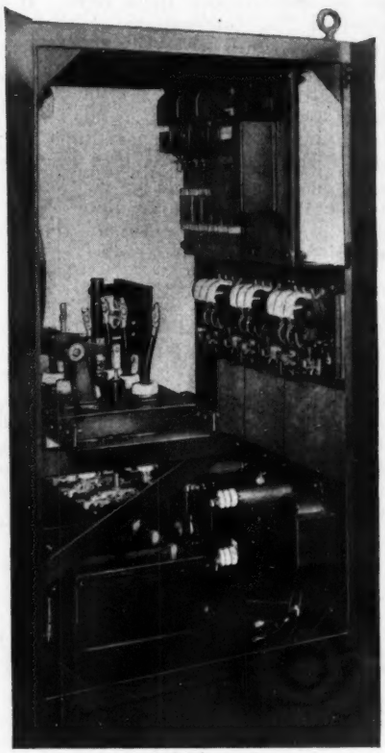


Fig. 1—Note the compact arrangement of the control equipment in this cabinet. It is designed especially to meet the conditions of electric shovel operation.

Fig. 2 — This cabinet is more elaborate than that shown in Fig. 1. Space is provided for mounting the generator field resistor.

At this time, the controllers and field resistors for the direct-current generators will not be considered. These are part of the variable-voltage control equipment, but, since they are mounted at the operator's stand at the front of the cab and present an entirely separate problem, they are not involved at this point.

The conditions under which the equipment on an electric shovel operate are special and are probably as severe as or more severe than conditions encountered in any other industrial application. Although standard industrial control type of apparatus in general successfully meets these severe conditions, special consideration must be given to each individual case where a

piece of such apparatus is being applied to shovel service, with a view to securing the best possible conditions under the circumstances and giving the apparatus a fair chance of meeting the service.

Some of the conditions which enter into a consideration of this kind may be mentioned here as indicating the high standard of performance which the apparatus used is meeting.

Vibration is very severe. This includes not only extremely heavy jolts and shocks caused when the shovel meets heavy obstacles in the digging in the banks, but also a high-speed vibration caused by the operation of heavy gear trains. In Diesel-electric equipment another type of vibration is caused by the Diesel engine itself. Altogether, the vibration is easily as severe as that encountered in high-speed trolley service.

Dirt, dust, moisture, grease, and oil conditions vary considerably with individual machines and operators. Standard equipment for application to the average installation, however, should afford protection against extreme conditions of this sort.

Maintenance and service to the electric equipment on the shovel is infrequent, on the average, or even omitted altogether. Only in rare instances is a first-rate maintenance service provided and, for the most part, it is provided only when failure of the equipment indicates the need. In general, control equipment, which is of a nature not readily understood by shovel operators, should preferably be so mounted and housed as to be inaccessible to anyone except the electrician or regular service man who may be called upon to take care of it.

An important point in the design of shovel equipment is to keep the space required for mounting to a minimum. Space in the shovel cab is limited, and, since most of it must be taken up by the shovel machinery, the motor-generator set, and the passageways needed to secure accessibility, very little is left for the control equipment. These parts must therefore be designed or selected for the most compact type of assembly.

Selection of the control equipment for use on shovels must therefore be given careful consideration. The problem is further complicated by the fact that the equipment should be suitably arranged for protection against dirt, for proper maintenance, and to meet space limitations.

A satisfactory solution is presented by the combination control cabinet. The standard type of cabinet with control mounted in it is shown by the photograph in Fig. 1. Fig. 2 shows a more elaborate type of cabinet, which has several special features, including space for mounting the generator field resistor. Both of these equipments are for the control of induction motor-driven shovel equipments. However, provision of a similar layout for either automatic or hand control of synchronous motor equipments would be entirely possible. In this connection, automatic control of the synchronous motor field should be a real asset, as shovel operators usually find it hard to understand just how to handle this manually when starting the synchronous motor.

Notice should be taken that all the alternating-current and direct-current contactors, expulsion-type fuses, field rheostats, and similar equipment for control of the various accessories mentioned have been very neatly and compactly arranged. The cabinet is designed to occupy a minimum of floor space. All the equipment may be locked in, thus making it accessible only to authorized persons. It gives ample protection against dirt, dust, and moisture.

The whole structure has been very securely braced and reinforced to withstand heavy vibrations and to provide a firm foundation, upon which the various parts are mounted in such a way as to have the minimum amount of vibration transmitted to them. Conduit wiring, both incoming and outgoing, is brought up through the floor inside the cabinet, and this eliminates the possibility of trouble from accidental contact with, or injury to, any of the high-voltage or low-voltage circuits.

Hollow Copper Conductor Cable Finding Wider Use for Supervoltage Transmission

DEVELOPMENT of power in remote sections and the interconnection of power systems by different power companies have made necessary the transmission of large blocks of power over long distances. Electrical power losses are proportional to the length of the transmission line and the current to be transmitted. For a given block of power the current flowing in the conductor is inversely proportional to the voltage. By increasing the voltage the current is decreased, which in turn decreases the electrical losses. This makes high voltage transmission economical and most desirable. With the increased voltage, however, other electrical losses are encountered, chief among which is the so-called "corona loss." Corona loss may be defined as the electrical loss which occurs when the potential of a conductor is raised to such a value that the dielectric strength of the surrounding air is exceeded. This in turn results in an ionization of the air surrounding the conductor. The ionized air becomes a high resistance conductor and increases the power loss. This loss may be materially reduced by the use of a conductor having a sufficient diameter to prevent ionization of the air. The necessary diameter usually cannot be secured in the use of standard concentric strand copper cables.

The Anaconda-American Brass Company engineers anticipated as far back as 1922 the present-day need for suitable copper conductors for operating conditions applying to super-voltage lines of 132 kv. or over. The result was the design and manufacture of Anaconda hollow conductor cables. The first cable offered for the consideration of utility engineers was designed in May, 1923. This consisted of a metallic hose which formed a supporting structure for copper strands. These strands in turn were spiralled around the hose. This type of cable was thoroughly tested, but was abandoned after the engineers were convinced of its inefficiency. The inner core or hose did not contribute to the tensile strength of the conductor. In the few following years numerous other designs were made up and tested and a number of the designs using metallic arches and wooden supporting structures were found impracticable. The present design, which meets all requirements, was standardized in 1925. This design has an I-beam spiralled section which adds to the ultimate strength of the conductor, affording a maximum supporting strength. This type of conductor met with the general approval of public service companies operating high voltage lines.

Hollow conductor cables have been used with apparent satisfaction by the following: The Hydro-Electric Commission, Toronto, Canada (220 kv. bus-structure); Philadelphia Electric Company, Philadelphia, Pa. (220 kv. bus-structure); International Paper Company, Gatineau, Canada (132 kv. bus-structure); Utica Gas & Electric Company, Utica, N. Y.; Chile Exploration Company, Chile; and the Pan-American Petroleum Company, British Guiana. The Societa Meridionale, of Italy, recently placed an order for 1,800,000 lb. 300,000 circ.mil hollow conductor cables.

In the following several installations are cited where severe competition was met from aluminum:

1. The Hetch Hetchy project, San Francisco. The conductor was installed by the company in that portion of the transmission line where severe corrosion conditions were to be met. Approximately 2,000,000 lb., or 177 miles, of conductor was sold. The cable was composed of 30 wires surrounding a hemp core; diameter of individual copper wires, 0.1070 in.; diameter of cable, 0.750 in.; area of cable, 345,000 circ.mil.

2. The Pitt River project of the Pacific Gas & Electric Company. The conductor purchased was for service on transmission line of the Pitt River development to San Francisco. The line

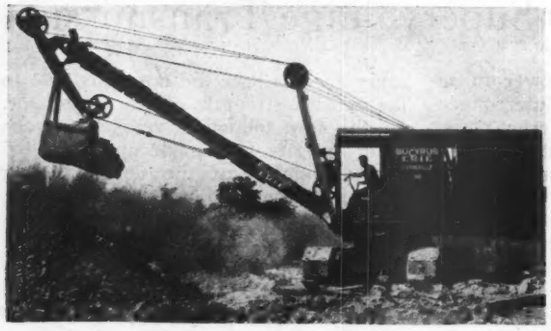
is 180 miles long, consisting of two 3-phase circuits, insulated for an operating voltage of 220 kv. The conductor is 500,000 circ.mil rope-lay copper cable made up of 7 ropes consisting of 7 strands each of 0.1010 in. wire; total circular mil area of the cable, 500,000; outside diameter of cable, 0.910. Approximately 10,000,000 lb. of cable was furnished on the initial order, and this order later was increased to 12,000,000 lb.

3. The Societa Meridionale di Elettricita's Naples to Pescara transmission line. An 118-mile, 3-phase, 60-cycle circuit operating at 154 kv. Diameter of cable, 0.769 in.; ultimate breaking strength of cable, 12,800 lb. This transmission line will operate between Naples and Pescara. Most of the line will be through the Apennines.

4. The Southern California Edison Company. A composite cable made up of 42 strands of hard-drawn copper, 0.1245 in. in diameter and 19 strands of Calsun bronze 0.1245 in. in diameter was furnished the Edison company as the conductor for its Long Beach to Lighthipe 220-kv. transmission line. This cable had an outside diameter of 1.121 in. with an ultimate breaking strength of 57,000 lb. The original requisition called for 60 miles of cable, or approximately 900,000 lb. This order was increased on Feb. 26, 1929, by an order for 100,000 lb.

Hollow conductor cables of minor importance have been sold to half a dozen other companies also.

The Equipment Review



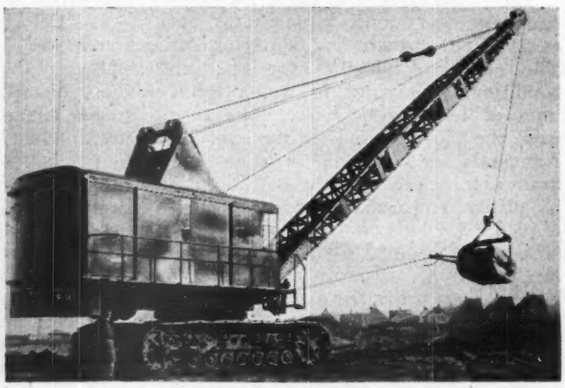
This 1-cu.yd. excavator may be used either as shovel, dragline, crane or clamshell

ANNOUNCEMENT of equipment of various sorts of interest to companies engaged in mining and metallurgical work has been made in the course of the last two weeks. Machines and apparatus introduced are described briefly in the following, the manufacturer in every instance being the authority for the statements made:

Two Convertible Excavators

The company that finds it necessary to use several different types of excavating machines will be doubtless interested in the new 1-yd. Diesel-driven drag shovel announced by the Bucyrus-Erie Company, South Milwaukee, Wis. The machine is easily convertible for use as shovel, dragline, crane, or clamshell. It is shown on this page. Consumption of the heavy fuel oil used is 15 to 20 gal. per day.

The machine is simply but strongly built. Its boom is of the latticed-channel type and the dipper handle is a steel casting of I-beam section. The dipper, built with an extra heavy arch to take the thrust to which it is subject, is built with long, chisel-shaped reversible teeth held in wedge-shaped sockets without bolts or rivets, this arrangement making it easy to replace and resharpen the teeth. The lines of the dipper are such that the runner can easily cut a smooth wall and decrease the time required for dumping. Dippers may be had either with solid or with hinged bottoms. With a standard 24-ft. boom and an 8½-ft. dipper handle, the machine is able to dig to a depth of 21 ft. and to a radius of 36½ ft. The clear dumping height for a front-opening dipper is 10 ft. 3 in., and the minimum dumping reach of the same dipper is 19½ in. The dipper of the solid type dumps within a radius of 17 to 30 ft.



A new 3½-cu.yd. dragline, which is convertible to shovel or crane of equivalent capacity

Another excavator has been added to its line by the Harnischfeger Sales Corporation, Milwaukee, Wis. This is the Model 900, 3½-cu.yd. machine, which is convertible for use as shovel, dragline, or crane. The revolving frame, carbody, and corduroy frames are single-piece annealed steel castings. The revolving frame is 19½ ft. long, over all, and weighs 17,000 lb., providing a rigid foundation for the principal machinery, including a 175-hp., six-cylinder Diesel engine. Anti-friction bearings are used throughout. The machine is illustrated in an accompanying cut.

The machine has a box-girder shovel boom, outside dipper sticks, and a 3-cu. yd. dipper. It may also be had with a 3½-cu.yd. bucket for dragline work. It is exceptionally mobile for a machine of this size. Steering brakes are provided so that the machine may be turned squarely around or in any desired radius. The tractions are gear driven and are of the non-clogging type. The over-all width of the machine is 14½ ft., and its length 25 ft.

A New Hand Shovel

An addition has also been made to the lines of hand shovels on the market by the Wood Shovel & Tool Company, Piqua, Ohio, which has introduced a new line of shovels, spades and scoops, known as the "Big Fist" brand.

INDUSTRIAL NOTES

Ohio Brass Company, Mansfield, Ohio, announces the opening of its new office at 2143 Railway Exchange Building, 611 Olive St., St. Louis. This office will be the headquarters of H. W. Kilkenny, district sales manager for the company in the St. Louis territory.

The Victor Welding Company, of 844 Folsom St., San Francisco, has been appointed distributor for northern California territory by the Stoody Company, Whittier, Calif., manufacturer of welding rods, alloy steels and welding equipment.

The Mine Safety Appliances Company, Pittsburgh, Pa., was awarded the Cecil G. Rice Safety Trophy at the annual banquet of the safety school conducted by the Western Pennsylvania Safety Council. The much prized trophy is awarded annually to the company in Western Pennsylvania having the best safety record for the previous year and is much sought after by all member companies of the National Safety Council. The announcement that the Mine Safety Appliances Company had won the award this year was received with enthusiasm. Considerable hazard is involved in its work, as it has to do with providing protection against poisonous and explosive gases. The company is continually working with these gases, and many of its employees are engaged in the dangers of rescue and recovery work after mine explosions and mine fires.

Personal Notes

Walter L. Penick has been in New York and has left for Salt Lake City.

H. R. Van Wagenen, mining engineer, of Los Angeles, was in New York last week.

H. L. Brown, of the American Metal Company, is in Nova Scotia for a week or ten days.

W. R. Ingalls announces the removal of his office from 115 Broadway to 33 Rector St., New York City.

W. A. Wilson, Salt Lake engineer, has returned to his home after a stay of several months in California.

George E. Collins has been in the Rico district of Colorado, inspecting the properties of Union Carbonate Mines.

George Stott, superintendent of the Bingham Prospect mine, at Bingham, Utah, was in New York on business recently.

J. V. N. Dorr left New York on March 23 for a motor trip from Denver to California, through the mining districts of the Southwest.

Ernest Craig is in charge of underground development work at the Falconbridge Nickel mine, in the Sudbury district, northern Ontario.

E. F. Burchardt, of the U. S. Geological Survey, has been granted a leave of absence of two months to engage in foreign commercial work.

C. Colock Jones, of Los Angeles, is in Lordsburg, N. M., examining the Bonney mine, now being operated by the Pacific Copper Company.

Prof. **W. P. Huleatt,** of the Colorado School of Mines, left Golden with a party of students on March 17 to visit mines in Colorado, Utah, Montana, and Wyoming.

S. J. Gateway, general superintendent of London Gold Mines, has been elected president of the recently formed Park County chapter of the Colorado Mining Association.

C. W. Henderson, head of the Denver office of the U. S. Bureau of Mines, addressed the Colorado Engineering Council at the Adams Hotel, in Denver, on March 19.

D. F. Haley, consulting engineer, of Joplin, Mo., has just returned from Custer County, Idaho, where he made an examination of the property of the Livingston Mines Corporation.

E. S. Bardwell, superintendent of copper refineries at Great Falls for Anaconda Copper, recently addressed the Montana Society of Engineers on the topic, "The Refining of Copper."

L. T. Wilson, formerly manager of the Matawan plant of National Lead, has been assigned to other duties. **T. O. Koopman,** previously general superintendent, has assumed Mr. Wilson's duties.

Victor Heikes, of the U. S. Bureau of Mines, has been assigned to take charge of the San Francisco office of the statistical division of the Bureau. Mr. Heikes was in charge of the Salt Lake City office formerly.

J. Fred Johnson, consulting mining engineer and contractor of San Francisco and Wallace, Idaho, will return to Eureka, Utah, as general superintendent of mines for Chief Consolidated. Mr. Johnson served in this capacity during the Chief's period of greatest productive activity, resigning in 1924 to take a consulting practice, specializing in contracting work on difficult shaft and tunnel jobs. Two of the most difficult undertakings completed by Mr. Johnson in the last few years were the concreting of the Morning shaft, at Mullan, Idaho, and the concreting and deepening of the North Star shaft, at Grass Valley, Calif. Mr. Johnson's return to Utah is one of the first steps to be taken by Chief Consolidated in its program of expanding the scope of its operations at various strategic points in the Tintic district.

J. Fred Johnson

William H. Crago, at one time engineer for U. S. Steel, and more recently consulting engineer at the Flin Flon mine, in northern Manitoba, has been put in charge of the office of Canam Metals in Winnipeg.

Karl L. Kithil, mining engineer, of Denver, is supervising the driving of a tunnel on Mount Bross, in the Fairplay district of Colorado. A geophysical survey was made of the ground before tunneling operations began.

O. A. McCraney, superintendent of the Argonaut mine, near Jackson, Calif., has resigned to take charge of the Mount Shasta Silica Company's operations. Mr. McCraney, who has been superintendent at Argonaut for the last year and a half, will be succeeded by **W. E. Scott.**

Ryosaku Matsuura, of the Central laboratory of the South Manchuria Railway Company, at Dairen, Manchuria, is making an extended trip through the United States to study electro-chemistry and the metallurgy of light metals, such as aluminum, calcium, and magnesium.

D. C. Jackling and Mrs. Jackling are in New York City to attend the annual meetings of the Utah Copper, Kennecott, and Nevada Consolidated companies. On the trip East, the party stopped at McGill, Nev., and Salt Lake City, Utah, to visit the operations of the Jackling companies in those districts.

Charles A. Mitke arrived in San Francisco on March 15, after a stay of five months in Australia. He sailed for London from New York on the "Berengaria" on March 29. He will be in London for about one month and may be reached care of Mount Isa Mines, Ltd., Adelaide House, King William Street, London.

Arthur J. Bensuson, formerly manager of the Passagem mine, in Minas Geraes, Brazil, for John Taylor & Company, has been appointed general manager for the West African Diamond Syndicate, Ltd., of London. These mines are about 90 miles from Accra, the capital of the Gold Coast. About 1,700 natives and 17 Europeans are employed.

Bertram S. Ashley, of Haileybury, Ont., has been elected president and managing director of Canadian Aërial Exploration, which will engage in prospecting work with the aid of airplanes. Mr. Ashley has been engaged in the Canadian mining industry for about twenty years. He was associated with Porcupine Goldfields Finance & Development as field engineer for a considerable period.

OBITUARY

Peter Moyer, mine promoter, who controlled several operations in Arizona and Colorado, died in his Denver home on March 14.

Samuel J. Lewis, mine operator, who owned several properties in Mexico, died in Mexico City on March 13. He was 49 years old.

Charles A. Hamilton, for more than 40 years identified with Mexican mining, died on March 12 at his home in Taviche, near Oaxaca City. Mr. Hamilton was associated at different times with the Haggin, Hearst, and Burns interests in Mexico. He was 79 years old.

William Longworth, a pioneer in Australian mining fields, died at Karuah, New South Wales, recently. Mr. Longworth was a member of the original syndicate that owned the once famous Cobar mine, in New South Wales. He went to Australia when he was a child and was connected with mining from the beginning of his business career. Toward the end of the last century, he and his associates obtained a lease on the Cobar copper mine, 500 miles from Sydney. By the introduction of what was then modern machinery, the mine was made to pay. Later it was sold to an English company with a capital of £1,500,000.

Digest of Foreign Literature

Rotary Kiln Roasting. Hoffman. *Metall und Erz,* Jan. No. 1, pp. 4-12. Of the many efforts to work up low-grade zinc ores, unsuitable for distillation, and to remove zinc from ores of other metals, hydrometallurgical methods have had much attention. The rotary kiln principle has now been successfully applied to this problem. In view of previous uses of the rotary kiln in other metallurgical processes, and its extensive use in making cement clinker, the new adaptation might appear to be a simple matter; but numerous difficulties had to be overcome, and the optimum procedure must be ascertained for each ore to be treated. The essence of the method is that the zinc-bearing ore is treated to convert the zinc to its oxide, which is then reduced by heating with a carbonaceous fuel. Thus, the zinc metal is volatilized and reoxidized. The heat balance of these reactions yields a considerable excess of thermal energy, most of which is utilized in the reaction zone. For successful volatilization of zinc certain conditions of temperature, oxide reduction, and reaction time must be met; and the rotary kiln meets these conditions particularly well. The radical difference between cement clinkering and zinc ore treating is illustrated by the zone relations; in making cement the preheating zone occupies 60 per cent of the length of the kiln, and the calcining zone 40 per cent, whereas in the zinc-ore treatment preheating occupies only 20 per cent and the effective reactions 80 per cent of the kiln length. This rotary kiln principle can also be applied successfully to low-grade lead ores; it yields a high-grade concentrate at low cost. The fineness of this concentrate presents some difficulty, but the cost of recovering its lead content is not great.

Volatile Metal Compounds. Kohlmeyer. *Metall und Erz,* Feb., 1st No., pp. 62-6. Volatilization as it occurs in metallurgical processes is discussed, with separate consideration of desirable cases (where volatility is utilized to effect separation of a metal or compound) and undesirable cases (where volatilization lessens yield or increases costs). Vapor pressure curves up to the boiling or subliming points (1 atm.) are shown for several heavy metals and for some of their oxides, chlorides, and sulphides. Most metals are less volatile than their oxides, but cadmium and zinc are exceptions to this rule. Zinc oxide is much less volatile than is generally supposed; it has no known melting point, but sublimes somewhere above 2,000 deg. C. Tin oxide is still less volatile, but ores or slags containing stannic oxide or its compounds can be reduced with coke in a converter and the tin can be volatilized. Whether this can be done profitably or not is not yet known; the thermal relations of the process are not favorable to a high yield of volatilized tin. Thermal relations are more favorable for the treatment of lead oxides or sulphides with coke in a converter, but even in this process there is considerable loss caused by lead remaining in the slag. Not much work has been done on the volatility of the noble metals and their compounds. Silver in particular is interesting because it oxidizes readily. If its oxide, following the usual rule, is more volatile then the metal itself, there may be losses in the metallurgy and refining of silver. The sulphide is probably even more volatile than the oxide. Laboratory studies will not solve such problems; observations made in actual practice are needed.

"It" Curves. P. Rosin. *Metall und Erz,* Jan. No. 2, pp. 29-36. Maximum thermal yield for a combustion process can be readily ascertained by plotting heat content (I) of the fuel and the flue gas against temperature (t). This principle can be made to give useful information when applied to metallurgical processes, in which working temperatures and efficient utilization of heat are important matters. The *"It"* curves for the metals themselves are also helpful. These curves are shown for Sn, Bi, Cd, Pb, Zn, As, Sb, Ag, Au, Pt, Ca, Cu, Cr, Mg, Al, Mn, Fe, Co, and Ni. Other charts, utilizing *"It"* curves, show a comparison of thermal efficiency of gaseous and solid fuels in melting these metals; maximal preheating temperatures with coal and with gas; the theoretical minimum fuel consumption for several metals; thermal efficiency as a function of heat content and melting points of various metals; effect of preheating on thermal efficiency (with separate curves for several solid and gaseous fuels); and the fuel consumption and effect of excess air supply, for the same list of fuels. In plotting the curves for theoretical thermal efficiency, transfer of the heat from the hot gases to metal or ore without any loss is assumed, and differences to be expected in actual operation are discussed. Due consideration is given to the facts that ore reductions are time reactions and that time is a factor in every process of heat transfer.

Sulphuric Acid. Walter Schopper. *Metall und Erz,* Jan. No. 2, pp. 36-41. Sulphuric acid may form spontaneously in gases from copper smelting furnaces, and from Bessemer converters used in treating copper ores. This does not occur as long as the gas is kept dry—that is, above its dew point; but if condensation of water is permitted, acid is formed and both iron and masonry are attacked. The acid also interferes seriously with the action of the electrical fume and dust precipitators. In the Dwight process, however, there is little acid formation, even though the sulphur dioxide content of the gases is relatively high and considerable condensation occurs. It is shown that by a suitable watching and control of the gas temperatures the formation of sulphuric acid in such flue gases can be avoided, at least to such an extent that the acid concentration in the gas will come within the tolerance limit for satisfactory operation of the electrical dust precipitators. Temperature curves and sulphur dioxide concentration curves are shown. Observation showed that acid formation was most active at 600-700 deg. C., which is attributed to the catalytic effect on sulphur dioxide oxidation of certain metal oxides which are most active in that range. It is therefore essential to keep the gas cooler than the temperature of active catalytic oxidation.

Delphia System. Ebeling and Braunsteiner. *Zeitschrift für egsamte Schiessund Sprengstoffwesen,* Jan., pp. 1-6. The Delphia system of blasting for mines, quarries, and the like consists essentially in the insertion of a plug between the explosive charge and the tamping. When a charge fails to explode, the tamping can then be easily and safely removed and a new cartridge introduced into the borehole on top of the unexploded charge. A variety of plugs have been designed for the purpose, some being for fuse firing and some for electric firing. For fuse firing, for example, an 8-cm. fireproofed beechwood rod, having a hole through its center for the fuse, is provided. It is claimed for this system that the charge practically never fails to explode, that safety in mine blasting is greatly improved, that greater effect is obtained from a charge, that firing is possible even in a wet borehole, and that blasting costs are lessened. In a critical analysis and discussion of the system and its merits it is here stated that these claims are largely overstated and that the costs of blasting would be increased rather than decreased. Balancing the demonstrated merits against the disadvantages it is concluded that the Delphia system, or any system based on a like principle, is not a desirable innovation in mining practice.

Lead and Cadmium. Richard Lorenz and Margarete Hering. *Zeitschrift für anorganische Chemie,* Jan. 22, pp. 33-48; Feb. 1, pp. 337-45. In a solution of lead and cadmium in their fused chlorides there is a chemical equilibrium between $Cd + PbCl_2$ and $Pb + CdCl_2$. Addition to the salt phase of this system of a chemically inert salt, namely NaCl or KCl, shifts this equilibrium toward the metallic lead side, so that the system becomes richer in lead and poorer in cadmium. The reverse is true when a metal, such as antimony or bismuth, is added to the metal phase of the system. When such additions are made to both phases at the same time, the first effect is to enrich the cadmium at the expense of the lead; but as the amount of additions is increased, this is reversed and enrichment of the lead begins. When bismuth is added to the metal phase, the effect of adding a salt to the salt phase is much greater than when antimony is used instead of bismuth. Curves and tables of numerical data show the experimental results of numerous salt and metal additions and their effect on the concentrations of lead and cadmium.

Furnace Practice. Maurice Cook. *Metal Industry* (London), Jan. 11, pp. 51-4. Improvements recently developed in the design and use of furnaces for non-ferrous metallurgical processes are reviewed. Notable among these are the increased efficiency and lessened fuel consumption of reverberatory furnaces for melting and refining. These improvements are partly due to the adaptation of oil and powdered fuels to the firing of reverberatory furnaces. Although electricity costs much more per unit of thermal energy than other fuels, it has several advantages which are causing increased use of the various types of electric furnace.

NEWS OF THE WEEK

Summary

ACCORDING to advices received from Mexico City, the revolution in Mexico has affected operations only in Chihuahua, Sonora, and Jalisco. Mines at Amparo and Cinco Minas have practically closed down because of lack of transportation. Page 536.

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Miami Copper is deepening its No. 5 shaft in preparation for converting the 1,000 level into the main haulage level when mining operations necessitate extracting ore from greater depths. Page 533.

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The Ontario government will undertake water-power development at Ear Falls, thus assuring Howey Gold of adequate power supply for metallurgical operations. Construction of 500-ton mill will be begun immediately. Page 535.

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Big Missouri Mines has acquired control of two properties in Elko County, Nev., and is conducting an intensive development program under the direction of Duncan MacVichie. Page 533.

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Hudson Bay Mining & Smelting has completed transportation of 23,000 tons of supplies to its power site at Island Falls, Saskatchewan, from the Flin Flon mine. Page 536.

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A large sulphur deposit has been discovered near Calama, Chile, according to dispatches received here. Estimates place tonnage at 200,000,000 tons of 99.99 per cent sulphur. Page 534.

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The Hercules mill, in the Coeur d'Alene district, is being enlarged to handle the increasing output from the mines controlled by the Day interests. Page 535.

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Development work at the Aldermac mine has failed as yet to locate the high-grade orebody indicated on the 1,125 level by diamond drilling. The company has located five distinct orebodies to date. Page 536.

U. S. Geological Survey Celebrated Its Fiftieth Anniversary on March 21

By PAUL WOOTON
Special Washington Correspondent

MEMBERS of the U. S. Geological Survey, their former associates, and their friends to the extent of more than 600 assembled in Washington on March 21 to celebrate the fiftieth anniversary of the establishment of the Bureau. They were received at the White House by President and Mrs. Hoover. They listened to the new Secretary of the Interior and other prominent speakers in the afternoon and at night were entertained at a banquet, which was followed by skits of the gridiron type.

The entire party called at the White House, where all shook hands with the President in the executive offices. The President went with the party into the grounds, where a photograph was made. At the express request of President Hoover, Dr. Waldemar Lindgren, professor of economic geology at the Massachusetts Institute of Technology, stood at his side when the picture was taken. Professor Lindgren had been his chief thirty-five years ago in the conduct of work for the Geological Survey in the Sierra Nevada Mountains. The party then assembled in the East room, where Mrs. Hoover addressed them. She referred to the fact that she felt at home among geologists because she had been a student of that science and in a way regarded herself as belonging to the fraternity. She spoke feelingly of the late Dr. John C. Branner, her instructor in geology at Stanford. In addition, she related several incidents of college days.

Dr. George Otis Smith, who has served as Director of the Geological Survey since 1907, in the course of remarks at the afternoon session, which was held at the Smithsonian Institution, said:

"Not only has the Geological Survey—our Alma Mater—been the mother of men, but as the scientific and engineering work has expanded the Survey has become the mother of bureaus. The work now being done by the Bureau of Reclamation, the Bureau of Mines, the Bureau of American Ethnology, the Forest Service, and the Geophysical Laboratory of the Carnegie Institution had its inception in the Geological Survey. We recall with pride that three out of four directors of the Reclamation Service and four out of five directors of the Bureau of Mines have been graduates of our Survey.

"During its 50 years of useful engineering the Survey has had its allowance gradually increased from $100,000 for the fiscal year 1880 to more than $2,000,000 for the fiscal year 1930. The expenditures for the half century have been $75,000,000, of which nearly $10,000,000 has come from state co-operative funds. Most of the work on which these many millions have been expended may be described simply as fact-finding. These 50 years in our country's history have been the period of its greatest development. The mineral industry, for example, has increased fifteen-fold since the Geological Survey made its first census of mineral production."

Secretary Wilbur, who delivered the principal address at the afternoon session, said in part:

"The U. S. Geological Survey is an example of the service which science can render to government. The geologist, with his trained mind, has made a study of that part of this great continent which is in our possession. Through years of endeavor and the work of thousands of trained men, we possess a fund of information regarding our mineral, water, and soil resources which guides much of our national policy in various fields. It is obvious that without the help of the expert we would have floundered in our conquest of the natural resources of the country. Upon the imaginative mind of the geologist and his capacity to visualize the treasures stored below the surface of the earth depends much of our future national welfare. In the Geological Survey we have had much that was practical but also much that was fundamental.

"It has been customary in government, with the needs of agriculture, public health, and in other fields, to set aside a certain amount of money and certain bureaus for those studies requisite for security. There has been, too, a fortunate tendency to increase the amount of work done in government laboratories which can be classified as of a fundamental character—that is to say, searching for truth for its own sake rather than for practical procedures immediately applicable to daily life.

"Essentially, research depends upon a large amount of reserve time which can be used by men of great curiosity and industry without the supervision of others except in the broadest way. The ordinary administration of government, the ordinary handling of budgets, do not lend themselves well to research. It requires its own technique. In it there will always be an ap-

The members of the U. S. Geological Survey call on the President. Mr. Hoover may be seen in the first row in the left center, with Dr. Smith on his left and Professor Lindgren on his right

parent waste of time and false leads. Most leads in the great unknown are apt to end blindly. The discovery of new facts, which, once discovered, become the eternal property of man, is full of hazards and uncertainties.

"In some ways the research worker has as difficult a task as that of a blind man trying to thread a needle. Many attempts must be made before success is assured. Because of this it is most important for the modern democracy to set up its relationships to science from the standpoint of the budget in such a way that funds will not be tagged for specific purposes. Funds should be made available for the securing of the best brains possible and for the facilities that they require, in order to pursue the unknown. While this function is carried on by many independent institutions and as a part of great industrial concerns, nevertheless it seems to me that since science and government are so closely related, government itself must make liberal grants for investigation and research."

Dr. Arthur Day, Director of the Geophysical Laboratory, spoke on earth physics.

Henry Fairfield Osborn sought to establish that Thomas Jefferson was the pioneer American paleontologist. Arthur Morgan told of the practical value of topographic maps and water resources data. At the dinner the speakers were Wallace Atwood, E. W. Berry, and Representative Corey of Pennsylvania.

By way of entertainment three skits were produced. One was "Rain," a play in one act "based upon the activities of an organization engaged in the study of certain consequences of a natural phenomenon of that name." The second skit was a take-off on the conservation branch, while the third was "The Follies of 1879." Those in attendance agreed that the Survey has a wealth of histrionic ability. John H. Renshaw was the only member of the original organization present.

Bad Roads Delay Concentrate Shipment from Cedar Creek

SHIPMENT of silver-lead concentrate from the Cedar Creek mine, in the Coeur d'Alene district, Idaho, was held up for some time by the congested conditions of the road to the railroad. Sleighs were finally resorted to, and the operations are now on a normal basis. Because of the delay, however, the directors were forced to levy an assessment, so as to meet current expenses pending returns from the smelter. The road is now cleared.

The mine is reported to be in good condition, both above the main tunnel level and in the shaft. On the 200 level, a crosscut is being run to the footwall of the vein, where the management expects to strike another oreshoot. The present oreshoot on the 200 level has been developed for 160 ft., with the face still in ore. The mill is operating on a two-shift basis, but this will soon be increased to three.

North Lily Drifting to Chief Consolidated Winze

Work of connecting the North Lily shaft with the winze in the Chief Consolidated's Tintic Bullion property in the East Tintic district, Utah, is progressing from both ends. About 36 ft. a day is being driven. On the completion of this connection, pumping in the North Lily shaft will no longer be necessary, unless additional water is struck when shaft-sinking below the 1,500 level is resumed. A new shaft will be sunk on a promising lime formation, recently encountered in a winze. Diamond drilling will also be started in several places in the mine, according to J. S. Finlay, superintendent.

Ophir Mono Developing High-Grade Ore

Ophir Mono Mines has opened two faces of high-grade ore in the Mono limestone bedding at its property in the Ophir-Dry Canyon district, near Stockton, Utah, according to M. C. Godbe, manager of the company. The ore is 900 ft. below the surface on the dip of the formation, and the faces are 400 ft. apart. They are in channels parallel to that mined by Matt Gisborn about fifty years ago, from which he produced about $1,000,000 in silver, lead, and gold. Ophir Mono Mines recently completed the purchase of the Mono group, covering sixteen acres.

Leases Silver-Lead Mines Near Chewelah, Wash.

O. C. Niles and associates have taken a five-year lease on the Chewelah Silver mines, near Chewelah, Wash., and are installing machinery to continue development work. The properties consist of the Fred B. and Jay Gould mines, totaling eight claims, which show high-grade silver-lead ore in a granite-quartzite contact. Two tunnels, each about 800 ft. long, were driven by former operators. These properties have changed hands frequently, having been operated successively by the Jay Gould Mining, New Currency Mining, and Chewelah Silver Mining companies.

Four Miners Killed by Snowslide Near Lake City

SNOWSLIDES in southwestern Colorado killed four miners employed by Empire Chief Mining, operating near Lake City, on March 25 and isolated several mining towns in the district, according to Associated Press dispatches. Approximately thirty slides occurred during the night. The bodies of the four victims were taken by couriers on skis to Lake City, 12½ miles from the property. The surface buildings at the property were completely destroyed by the hundreds of tons of snow that slid down the mountain sides. Empire Chief operates the Highland Chief and other silver-lead mines on Sheep Mountain, near Henson Creek.

Further south, at Silverton, which was isolated once last winter for a period of three weeks by snowslides, another slide recently occurred that destroyed power lines serving several mines. Three feet of snow fell at Silverton, and the barometer showed 10 below zero weather, despite the fact that spring, according to the calendar, has officially arrived.

Horn Mine Open to 1,100 Ft.

The main shaft of the Horn Silver mine, at Frisco, Beaver County, Utah, has been opened to the 1,100 level by the Tintic Lead Company, and leasers are now working on every level from the 1,100 to the 100. A carload of mine cars was received at the property recently, and production of silver-lead ore has been started.

Miami No. 5 shaft and crushing plant

Miami Preparing 1,000 Level to Be Used for Haulage

MIAMI COPPER is preparing to sink its No. 5 shaft, at Miami, Ariz., from the 1,000 level to the 1,120. The contract has been let to the E. J. Longyear Company and sinking is to begin in April. The 720 level is the mine's haulage level at present, but as mining operations progress, ore will have to be transported to the shaft on the 1,000 level. Shaft sinking operations are for the purpose of getting the next haulage level station and loading pocket ready for use. The floor of the new pocket will be 86 ft. below the 1,000 level. The 1,120 level will be equipped to take care of the skip-spill muck, which falls from the pocket during loading operations.

At one time Miami had a winze from the 1,000 to the 1,800 level. The winze was a continuation of No. 5 shaft, but smaller in size. A year or so ago, the ground around the shaft at the 1,000 level began to get heavy and it was necessary to fill the winze with tailings to preserve the shaft pillar. The air line between the 1,000 and 1,800 levels is still in place and has been converted into an air lift for dewatering the ground in preparation for the sinking operations.

The 720 level, however, will be the haulage level for many millions of tons of ore yet to be mined. At present loaded ore trains on this level, coming to the pocket to dump, and empty trains going back into the mine, must use the same stretch of track for the first 1,000 ft. from the shaft. A new drift is now being driven for the empty trains, and, when it is completed, no track on the level will have ore trains passing over it in both directions.

Big Missouri Obtains Control of Two Nevada Mines

BIG MISSOURI MINING, which owns a property in the Portland Canal district of British Columbia, now under option to Consolidated Mining & Smelting, has acquired stock control of two companies operating in Elko County, Nev. Development of the properties of these companies—Missouri Monarch Mines and Black Forest Mining & Smelting—has been under way for some time, with Duncan MacVichie, representing Big Missouri, in charge. E. E. Gardiner, formerly at the Highland Boy mine, at Bingham, Utah, is superintendent.

The properties are 25 miles south of Tobar, on the Western Pacific Railroad. Exploration is being carried on at two points in the 2 miles of limestone fissures lying within the 1,036 acres now under control by Big Missouri. The upper Black Forest tunnel is being lengthened and a shaft is being sunk from the Spruce Monarch tunnel, on the west side of Spruce Mountain. During the last session of the Nevada Legislature, a bill providing a franchise for the construction of a railroad from Tobar to the Spruce Mountain district was passed. This railroad will be built, it is said, provided the company is successful in opening up a sufficient tonnage of ore.

Quincy Increases Labor Force to Permit Shaft Sinking

QUINCY has been gradually increasing its force of miners at its mine in the Michigan copper district as the program of opening work has expanded. With the reopening of No. 2 shaft and the decision to sink all three units and open levels between them, larger forces have become necessary. Three shifts of men are at work to hasten these development operations. Extensive openings are required before Quincy can adopt the retreating system of mining. Drifts must be run to the limits of the copper courses, and this will be the procedure also as new levels are opened. No stoping will be done until later in the year.

The ore now being sent to the mill comes from the drifts. The program being followed is designed to perpetuate the life of the mine and make its physical condition safe.

Arizona Copper Miners Win Several Awards for Heroism

THE humanitarian side of the mineral industries was emphasized in the awarding by the Joseph A. Holmes Safety Association, at its annual meeting in Washington, of medals, buttons, and diplomas to individual miners who had performed notably courageous feats in rescuing or attempting to rescue comrades entrapped underground in time of accident or disaster. Diplomas were awarded to individual mine officials and to mines which had achieved records of long-continued operation with remarkably small numbers of accidents.

Gold medals, given in recognition of the performance of an act which results in the saving of life at the risk of one's own life, were awarded to E. J. Bellah, an Indian, and Michael Marchello, for heroism displayed on the occasion of a fire in the hoist house of the Teejon copper mine, Gleeson, Ariz., on May 6, 1928. On discovering the fire, Bellah, the hoistman, summoned Marchello, who descended to the 200 level, traveled 1,000 ft. underground, and notified four miners of their danger. The four men, with Marchello, entered the cage and were hoisted to the surface by Bellah, who had stuck to his post. When the men reached the surface, the headframe, the hoist house, change house, and blacksmith shop was ablaze. Bellah was in the middle of the fire. While hoisting the men, an air receiver blew up within 10 ft. of him. His hand was badly burned, as were also his right arm and shoulder. By sticking to his post under these trying circumstances he probably saved the lives of five men who might have been smothered to death, since the burning headframe later fell into the shaft.

A gold medal was awarded to Zeno Daley, an Apache Indian, in recognition of a courageous act performed during a fire in No. 2 shaft of Magma Copper, at Superior, Ariz., on Nov. 24, 1927. Daley lost his life in attempting to go to the relief of 49 men entrapped underground. With his cage he was lowered into the burning shaft, after failure to receive signals from a rescue party which had previously gone below. The cable of the cage was burned through by the fire and, with its attendant, it dropped into the burning shaft.

Diplomas awarded in recognition of an act performed with others collectively, though unsuccessfully, at personal risk in the attempt to save life, were awarded to the 26 employees of the Morenci branch of Phelps Dodge, at Morenci, Ariz., in recognition of a valorous effort to rescue fellow miners who had fallen victim to poisonous gases produced by the firing of explosives on Nov. 15, 1928. Of the 26 men who took part in the vain attempt to rescue two fellow miners overcome by gas resulting from the firing of dynamite blasts, several were themselves rendered unconscious. Knowledge of first-aid methods on the part of these men revived those who were so overcome.

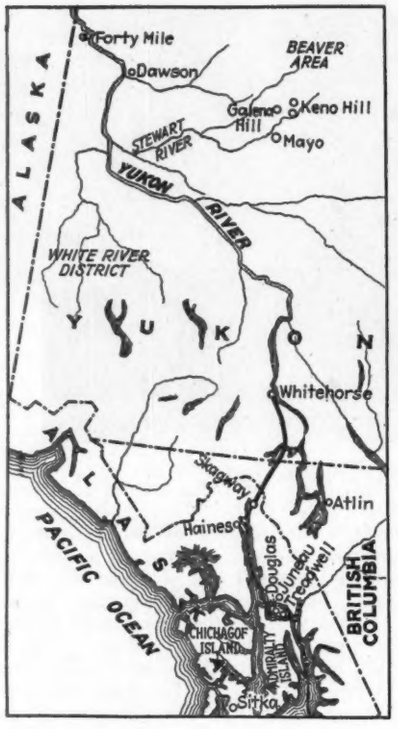
Treadwell Yukon Strikes High-Grade Ore at Keno Hill

TREADWELL YUKON developments on Galena Hill, in the Keno Hill silver-lead district, Yukon Territory, are progressing steadily, but have been somewhat handicapped by late arrival of wire for the new power line. This line connects the company's operations on Galena Hill with the Wernecke Diesel-engine plant on Keno Hill, and is now in service. At the Brefalt property, on Galena Hill, operations have been greatly facilitated by the use of this new source of power.

Three tunnels have been driven at this property during the winter, tapping the orebodies at different points along the strike of the main vein. One oreshoot tapped recently is said to be the highest grade deposit ever found in the district. The original owners of the claim had mined above it, and missed striking it by only 3 ft.

A deep shaft is being sunk on the Settlemier & Bermingham group, also on Galena Hill, and prospects are understood to be satisfactory. On the Silver King claim, a mile south of the Brefalt group, a good shoot of high-grade ore was struck last winter by McHugh and McLean, leasers.

The accompanying map shows the location of the district. Ore is hauled to Mayo from Keno Hill by tractors, and then shipped down the river to Whitehorse. There it is loaded on trains to Skagway, where it is again transferred to ships bound for Seattle.



Map showing mining districts of Yukon and southern Alaska. Black line is railroad route and dotted line is steamship route used in shipping ore to Seattle.

Report Discovery of New Sulphur Deposits in Chile

Enormous new deposits of sulphur have been discovered at Putana Volcano, near Calama, in the province of Antofagasta, Chile, according to a cable report received by the Consul General of Chile in New York, on March 25. Estimates place the size of the deposit at 200,000,000 tons of sublimated sulphur of 99.99 per cent purity, and the quantity in the deposits of inferior grade is said to be incalculable. Details may be obtained from the Chilean Consulate, 17 Battery Place, New York City.

Flintoba Mines Adds to Holdings in Manitoba

Flintoba Mines, which owns 1,050 acres in two groups, adjoining the Hudson Bay Mining & Smelting properties in the Flin Flon district of northern Manitoba, Canada, has added to its holdings in northern Manitoba by the purchase of a block of 850 acres, known as the Thompson Lake group, for which negotiations have been conducted for some time. Options are also held on 400 adjoining acres. J. C. Honsberger, mining engineer, has been in charge of development work at the Thompson Lake group. Four surface trenches have been run across the vein and show widths ranging from 6 to 27½ ft.

Higher Ore Price Stimulates Lake Superior Iron Districts

AN INCREASE of 25c. in iron-ore prices for the season is expected to result in marked gains in mining operations in the Lake Superior district. Both Oliver Iron Mining, U. S. Steel subsidiary, and independents have announced extensions in their operating plans. Mine officials are now sanguine that season's ore shipments will exceed 58,000,000 long tons. Besides an ore-price increase, local operators are hopeful of a downward revision in their state taxes as a result of possible passage of bills to alleviate their tax position, now under consideration by the state legislature. Tax cuts are, however, meeting with strong opposition from certain interests in range towns, and it is assumed that some changes will be deferred to enable towns to readjust themselves to lighter municipal expenditures.

The first stripping operation for the season has been started by Pickands, Mather & Company at the Mahoning mine, at Hibbing, the largest open pit on the range. International Harvester is reopening its Agnew mine, which has been idle for eight years. All active Oliver mines on Mesabi range will be operated this season, according to intimations. Manganiferous ore mines on Cuyuna range are expected to be more active than in several years. Underground mines on that range have had a good winter in stockpiling ore at surface and large tonnages are ready for shipment this spring.

Revised Ontario Mining Act to Be Submitted Next Session

THE Ontario government recently presented a revised mining act before the provincial legislature. This new bill was intended not only to provide for the recommendations of the royal commission investigating the Hollinger disaster, but also involved a redrafting of all the rules for the operation of mines. A large number of controversial points was found, however, and the government finally decided to withdraw the bill in order to give plenty of time, before the next session, to have it carefully drafted. Another bill has been introduced dealing only with regulations suggested by the royal commission. A summary of the proposed regulations follows:

Every foreman must be able to give and receive orders in the English language.

Mine inspectors shall have the right to suspend any foreman who is not familiar with the regulations of the Mines Act.

The location and type of buildings used for magazines and thaw houses must be approved by the Inspector of Mines.

All underground buildings for the housing and maintenance of machinery shall be constructed of fireproof material.

All fans except booster fans shall be above ground and shall be reversible.

Oil and grease underground must be kept in special metal receptacles and not more than one week's supply will be allowed down at one time.

Fire doors shall be installed where practicable at stations so that the shaft will be cut off from the rest of the mine.

All inflammable refuse must be removed from the mine every 24 hours and every shift boss and mine captain must report in writing once a week that there is no accumulation of inflammable refuse in his department.

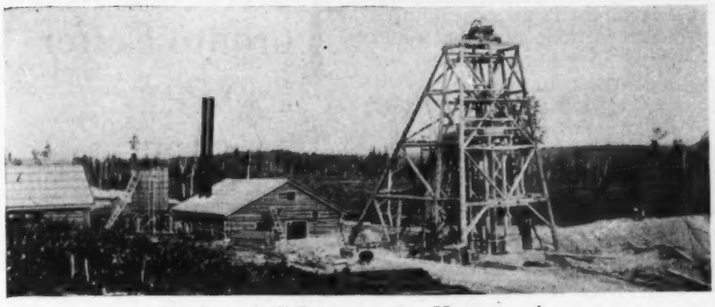
Fire-fighting appliances must be available at underground crusher stations and in dry shafts.

All mines having a capacity of 100 tons a day or more must have the necessary apparatus for introducing stench chemical in the air lines as a warning signal.

Legible signs must be posted showing all exits.

Dorit-Perkins Group, Near Idaho Springs, Is Bought

THE Dorit-Perkins group of mines, totaling 36 claims on Chicago Creek, Clear Creek County, 3 miles from Idaho Springs, Colo., has been purchased by an Eastern syndicate headed by C. J. McNamee, of New York. This property has been developed by two long tunnels to a depth of 1,000 ft. It carries gold, silver, lead, and zinc in a fissure vein. Until 1918, it was controlled by the now defunct Dorit Mining & Milling Company. Since then it has been operated by local interests, headed by F. L. Patrick. Equipment includes a 60-ton amalgamation-concentration plant, built in 1914, but which has been operated only intermittently. Electric power is available. W. C. Fischer has been put in charge of development by the new owners.



Surface buildings at the Howey mine

Power Supply for Howey Gold Now Assured

HOWEY GOLD MINES, in the Red Lake district, northern Ontario, has finally concluded its negotiations with the Ontario government for a supply of hydro-electric power. The development will be undertaken by the Hydro-Electric Power Commission of Ontario, and will cost about $1,000,000, according to estimates. The unit, which will be at Ear Falls, on the English River, will have a capacity of 5,000 hp. This development was rendered feasible by the construction of a great storage dam at Lac Seul at a cost of $300,000. The dam will be completed in April.

The Howey will obtain a better power rate than any mine of similar size in Ontario. Power will be sold at the mine at $32 per horsepower-year. This compares with a nominal charge of $50 in Kirkland Lake. Contracts in that district, however, are such that power costs for most of the producers are nearer $65 than $50 per horsepower-year.

With a supply of power assured, the company will now proceed with the construction of a 500-ton mill. The flow sheet has already been worked out, and tests on the ore are said to have given satisfactory results. About a year will be required to complete the mill and power equipment. Ore averages about $7 a ton. The shaft, now down to 700 ft., is being sunk to 1,000 ft., and new levels are being opened up every 125 ft.

Hercules Mining Will Increase Plant Capacity

THE capacity of the Hercules silver-lead concentrator at Wallace, Idaho, is being considerably increased by adding to the flotation equipment. This can be done without enlarging the size of the existing structure, as considerable space at the plant is unoccupied. The crushing department already is equipped to handle more than 700 tons daily, the present capacity of the entire plant.

Ore handled at the Hercules mill now comes entirely from custom sources, although most of it is from companies controlled by the Day interests, which own the Hercules. Operations at the Hercules mine were suspended in April, 1925, but the mill was not affected, as new sources of supply had been developed. At present, ore is coming from the Dayrock, Sherman, Hummingbird, and Tamarack & Custer mines.

The Tamarack & Custer mill was abandoned last spring, and ore shipments were diverted to the Hercules plant, because the management decided that operations could be conducted more efficiently by using the Mammoth tunnel, which is more accessible to the Hercules plant, as the main operating tunnel. Since then development work has disclosed considerable new ore at the Tamarack mine on the 600 level, and this discovery justified increasing mill capacity.

Development work at the Dayrock mine has also had favorable results recently, and that company has entered the ranks of the dividend payers. About twenty carloads of ore are being shipped every week. On the 300 level, the ore-shoot has been proved continuous for 1.200 ft. west of the shaft, and on the 100 level it has been followed east for about 600 ft.

No Ore Yet Found at Mayflower-Old Colony

In the remaining few hundred feet that Mayflower-Old Colony has yet to traverse in the exploratory crosscut west from the 1,700 level, at its property in Michigan, several veins opened in the footwall of the Kearsarge in exploratory work in the old Wolverine mine may be encountered. The lodes contained copper, but not in commercial quantity, where opened in the Wolverine. Possibly, however, these veins may be enriched farther to the south, in the Mayflower-Old Colony lands, so interest attaches to the opening of the next 500 or 600 ft.

May Build Concentrator at Ophir-Kelly Mine

The Ophir-Kelly property, 12 miles north of Trona, Calif, has been reopened, and a concentrator may be built in the near future to treat silver-lead ore. The property was worked by Engineers Exploration for several years, and ore of shipping grade was produced under the handicap of trucking to Trona.

Coeur d'Alene Mines Will Raise Wages April 1

EFFECTIVE April 1, wages at all mines in the Coeur d'Alene district of Idaho will be increased 50c. per shift. This decision was reached at a meeting of the managers of the larger operating companies on March 18. Applied to the present wage scale, the increase on April 1 means that miners will receive $5.50 per day and muckers $5 and that all other employees up to foreman will share in the increase. A conservative estimate places the number of men employed in the mines, mills and the Bunker Hill smelter at about 4,500.

During the last two years when the price of lead has been low, ranging between 6c. and 7c. a pound, the mining companies of the district have maintained wages on a basis which, according to the sliding scale adopted in 1916, represented the lead price at 7.5c. and under 8c. In other words, after the price dropped below 7.5c., the mining companies recognized that because of living costs it would be unfair to reduce wages. The new wage scale will represent lead selling above 8.5c. and below 9c., although the price is now only 7.75c. a pound.

Magma Will Install Additional Power Equipment

ADDITIONAL power equipment has been contracted for by Magma Copper, of Superior, Ariz. A 3,000-kw. Westinghouse turbine, reduction gear, and Westinghouse generator of equivalent size will be installed. The power house is now equipped with two 1,500-kw. Westinghouse geared turbines and generators. Supplementary equipment for the new unit includes a 4,826-sq.ft. surface condenser with motor-driven auxiliaries, and a compound LeBlanc steam-jet air pump mounted on a common surface-type into cooler and after-condenser, and two Westinghouse high-pressure feed-water heaters. It is expected that the new unit will take care of any possible power shortage that results through increased load, and that greater economy will result from higher boiler pressure and the greater efficiency of the larger unit.

Montana Idaho Changing to Flotation at Mill

Montana Idaho Mines Corporation is installing a flotation plant to handle the pyritic gold ores at its Spring Hill mine, near Helena, Mont., and will discontinue cyaniding this ore. This change was made after exhaustive testing by W. L. Ziegler, mill superintendent of the Hecla Mining Company, and the metallurgical departments of Idaho and Washington School of Mines. C. W. Newton, manager of the Callahan Lead & Zinc Company, was recently elected consulting engineer for the Montana Idaho Mines Corporation.

Mexico City Letter

By W. L. Vail
Special Correspondent

Only Chihuahua, Sonora and Jalisco Mines Affected by Mexican Revolution

Mexico City, March 18, 1929.—As far as reports received in this city go, the revolution in Mexico seems to have proved almost a complete fiasco. Mining interests have naturally been temporarily disturbed in a few districts of Chihuahua, Sonora, and Jalisco, and the ore supply of the smelters at Torreon and Monterey has been affected. However, the belief here is that the worst has passed and that within a few weeks a return to normal conditions will be effected. So confident is the government of the final outcome and its complete mastery of the situation that the President has issued orders renewing all permits to responsible mining companies for handling explosives, even in the disturbed districts of Sonora and Chihuahua.

In Jalisco, the mines at Amparo and Cinco Minas have practically closed down, not because of any disorders but because of inability to secure transportation. Oaxaca, Guerrero, Michoacan, and Sinaloa report normal mining activity. Some attempts have been made to interfere with operations in Lower California, but that territory has remained loyal to the government. A threatened paralysis of work at Cananea was avoided by the timely taking of the port of Naco, which left transportation to Cananea from the United States open. Zacatecas mines have continued operations despite attempts by the rebels to invade that territory. Local mining shares, which were affected the first few days, have returned to comparative stability and silver has practically recovered the position it held before the revolution began.

The president of the Chamber of Mines in Lower California has sent a strong protest against the present mining regulations to Mexico City. He states that of the two thousand properties listed on the peninsula, only three are now operating. In practice, he declares, the steps required under present mine regulations to obtain title to properties and keep up other requirements are so complicated, and the cost is so excessive, that the majority of small miners find it impossible to operate. He continues: "Taxes keep down the production. Prohibition of the exportation of gold, and the risks attendant to transporting it to the mint in Mexico City, at a cost of approximately 24 per cent of the value, tend to paralyze the operators completely, unless they have immense amounts of capital. Today an infinite number of useless requirements exist—registration, data on operation, and filing—with which we must comply and which result in large expenditures and loss of considerable time that could better be used in mining. When we have the misfortune to receive a visit from one of the innumerable inspectors who molest the industry, we must submit to the invocation of interminable rules and paying of large fines because of infractions of rules dealing with labor, with weights and measures, with sanitation, with emigration from state to state, with municipal service, with boilers, and with kindred subjects. Under these conditions it will be seen that the poor miner cannot do what seems necessary to conform to the exigencies of the new law."

Aldermac Development Fails to Check Diamond Drilling

Development work on the property of Aldermac Mines, in the Rouyn district, Quebec, has not yet located the high-grade ore indicated on the 1,125 level by diamond drilling, according to the annual report of the company, which has just been issued. A large body of low-grade ore has been cut, showing an average of 1.5 per cent copper for a width of 125 ft., of which 65 ft. averaged 2.2 per cent copper.

Five orebodies have been located to date. Nos 1 and 2 outcrop on the surface. They average about 6 per cent copper, but are small in size, and diamond drilling shows that they extend only a short distance below the surface. No. 3 was opened on the 125 and 250 levels, and has been cut by two diamond-drill holes at 500 ft., the average being 2.86 per cent copper, 2 oz. silver, and 58c. gold a ton. No. 4 body was encountered in the shaft at 412 ft. and continued in the shaft 286 ft. It was developed on the 500 level, the average being 1.75 per cent copper, 1.23 per cent zinc, 62c. in gold, and 0.6 oz. of silver. No. 5 orebody was opened on the 500 level. Work done so far indicates that this is the top of the orebody. An average of 2.3 per cent copper was obtained for a length of 27 ft. over a width of 4.6 ft. Diamond-drill hole No. 21 from the surface showed 4 ft. of ore averaging 14.55 per cent copper at 1,130 ft., but this ore has not yet been encountered on the 1,125 level.

Diamond Drilling Indicates New Orebody at Noranda

A diamond drill operating from the 975 level at Noranda Mines, in the Rouyn district, Quebec, has entered a highly mineralized section at a depth of about 1,225 ft. and has continued in it for about 60 ft., according to an official statement of the company. No assay results have as yet been announced, and only one hole has been put down, so that the extent of the deposit is not known. However, it is not the "H" orebody, but is believed to be an enrichment at depth of a large, low-grade, sulphide body which was struck on the south side of the 975 level some time ago.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Hudson Bay M. & S. Completes Transportation of Supplies for New Power Plant

Toronto, March 23, 1929.—Hudson Bay Mining & Smelting, operating in the Flin Flon district, northwestern Manitoba, has transported practically all of the 23,000 tons of freight for the Island Falls power plant. This freight has been taken to the site of the plant from the Flin Flon mine during the last two months by tractors. On some of the trips the tractors hauled more than 100 tons in one train. The distance is about 60 miles. Weather conditions during the last few months have been very favorable for tractor transportation in the North.

In regard to the receivership of Coniaurum Mines, mentioned in last week's issue, if operations are to be continued, mining men expect new capital will have to be provided. The present difficulty arises from the fact that development work on the 1,750 and 2,000 levels has been disappointing. The property adjoins the McIntyre-Porcupine. Early in 1928, $800,000 was raised by the sale of bonds to provide for construction of a mill and to put the mine in condition for production. However, returns from mill operation have not been sufficient to meet power and wage bills.

The last diamond-drill hole to be completed on the Vermilion Lake property of Sudbury Basin shows the highest grade of ore yet obtained. The width of the new ore is 45 ft., and the first 20 ft. show high-grade copper, in addition to other metals. A predominance of zinc occurs in the last 15 ft. The most interesting feature about this hole is that the ore was found in the tuffs underlying the sediments. Many engineers have contended that ore would be found only in the sediments, and this new work opens up interesting possibilities.

At the adjoining Errington mine of Treadwell Yukon, all work to date is still in the sediments, none of the holes being sufficiently deep to strike the tuffs. On the 500 level of No. 2 shaft, diamond drilling has cut 75 ft. of ore at a depth of 200 ft. below the level.

Tarbaby Tunnel Reopened by Howell Mining

Operations have been resumed in the Tarbaby tunnel, in Big Cottonwood Canyon, Utah, by Howell Mining. A rich streak of ore has been followed for 140 ft. The company is now crosscutting to the east to strike the Cardiff overthrust contact. When this work is completed, a drift will be run to the south into Howell ground.

MARKET AND FINANCIAL NEWS

International Nickel Earned $12,399,317 in 1928

ACCORDING to its annual report for the year ended Dec. 31, 1928, the International Nickel Company of Canada, Ltd., had net earnings of $12,399,317, compared with $6,064,544 in 1927. The report represents largely the status of the old International Nickel Company of New Jersey before the absorption of the Mond holdings had begun. The financial statement of the company follows:

Consolidated General Profit-and-Loss Statement

	1928	1927
Earnings of all properties after deducting manufacturing, selling expense, ordinary repairs, and maintenance	$16,076,595	$8,861,895
Other income, less interest on purchase money notes	629,999	123,729
Total income	$16,706,594	$8,985,625
Deduct administrative and head office expense General office expense	967,478	603,029
Reserved for federal and franchise taxes	1,188,678	614,498
	$2,156,157	$1,217,527
Net operating income	$14,550,437	$7,768,097
Deduct		
Retirement system and insurance reserve	556,765	.....
Orford works property expense	.....	108,156
Depreciation and depletion	1,594,354	1,595,395
	$2,151,120	$1,703,552
Profit for the year	12,399,317	6,064,544
Dividends, preferred	557,034	534,756
Common	4,331,095	3,346,768
Balance to surplus	$7,511,187	$2,183,020

Sales of metallic nickel in the United States were approximately 97 per cent in excess of similar sales during the previous year, and world sales of nickel, exclusive of the United States, increased approximately 52 per cent. Coincident with this large increase in the consumption of metallic nickel the sales of products from the Huntington works (principally Monel Metal and rolled nickel) increased by 35 per cent. The management attributes this rapid growth in business not alone to generally good business conditions but largely to new applications of nickel established through the efforts of technical and sales organizations, and to the fact that the vast amount of nickel steel scrap accumulated during the World War has been consumed, in consequence of which steel makers are largely increasing purchases of metallic nickel.

The smelter at Copper Cliff ran throughout the year exclusively on ore from the Creighton mine. During recent months matte production has been so increased that at present there is being produced approximately the same tonnage of matte per month as was required during the peak of war operations. Owing to uninterrupted operations and the large tonnage of bessemer matte produced, costs recorded are the lowest in the history of the plant. Development has not progressed sufficiently to permit accurate reports as to exact tonnages or average metal contents in the lower levels of the Frood orebody. Many feet of crosscuts have been driven, and reserves of high-grade ore sufficient to run the smelter for many years are now proved. On the 1,200 level, 100 ft. of ore has been crosscut, and channel samples show 1.77 per cent copper and 2.61 per cent nickel. On the 1,600 level, 48 ft. of ore has been crosscut, and channel samples show 2.90 per cent copper and 2.15 per cent nickel. On the 2,000 level, 39 ft. of ore has been crosscut, and channel samples show 2.09 per cent copper and 1.93 per cent nickel. On the 2,400 level, 64 ft. of ore has been crosscut, and channel samples show 3.6 per cent copper and 1.5 per cent nickel. On the 2,800 level, 139 ft. of ore has been crosscut, and channel samples show 12.14 per cent copper and 2.66 per cent nickel. The precious-metal contents, including platinum metals, are higher than in the Creighton mine ore, though reliable assays will not be available until the ore now being obtained from development work is smelted and the resultant bessemer matte has been analyzed and averages have been made.

During August, 1928, there was offered to both common and preferred stockholders the right to purchase additional common stock at the rate of $60 per share. From the sale of 202,988 of such additional common shares $11,869,828 was realized. This amount, in addition to the company's cash reserves, assures the completion of the Frood mine development program without further financing. Under the plan of reorganization referred to in the opening paragraph of this report, the holders of the $25 par common shares of the New Jersey company received six shares of no-par value common stock of International Nickel Company of Canada, Ltd. Holders of 6 per cent noncumulative preferred stock of the New Jersey company received share for share 7 per cent cumulative preferred stock of International Nickel Company of Canada, Ltd. In consequence of this stock split-up and exchange of shares, there was issued or issuable 11,258,208 shares of no-par value common stock and 89,125 shares of 7 per cent cumulative preferred stock of International Nickel Company of Canada, Ltd., on Dec. 31, 1928. The earnings for 1928, after allowing for preferred dividends at 6 per cent, were equivalent to $6.32 per share on the basis of 1,876,368 shares of the former New Jersey Company's stock, as compared with $3.30 per share earned on 1,673,384 shares of that stock in 1927. Earnings for 1928 in terms of the no-par value common stock now issued or to be issued for International Nickel Company of New Jersey stock, after allowing for preferred dividends on a 7 per cent basis, were equivalent to $1.05 per share. Net current assets of $30,463,474 are in excess of last year's figures by $12,824,777.

On Jan. 1, 1928, the directors installed a "retirement system" which provides service retirement, disability retirement, and death benefits for all of the company's employees. The system is noncontributory on the part of the employee and is financed entirely by the company. During the year ended Dec. 31, 1928, $456,765 was reserved from profits and applied to the "retirement system" fund. The amount disbursed for pensions, disabilities, and death benefits during 1928 was $111,075, leaving a balance in the fund at the end of the year of $345,689.

Throughout 1928 the company shared generously in the prosperity of the metal-consuming industries. Although increased sales were partly attributable to this cause, the management believes that in large measure the rapid growth of the nickel business is due to the technical and commercial efforts which have been continued without change or interruption for the last seven years. Alloy-steel manufacturers continue to be the largest consumers of metallic nickel. The quantity of nickel used in producing iron and steel castings doubled during the last year and the special alloy cast irons, mentioned in a previous report, are meeting with marked success. A promising new development engaging the attention of the company's technical department relates to the manufacture of magnetic nickel-iron alloys. These are high-percentage nickel alloys which are being rapidly exploited in the electrical industries and will, it is believed, require substantial quantities of nickel. The corrosion and heat resistant chrome-nickel-iron alloys are also coming into greater prominence and their applications are increasing. Nickel continues in large demand for plating, coinage, and the manufacture of various

non-ferrous alloys. During 1928 the mints in both Canada and the United States struck pure nickel coins. The coins made in the United States were for the Republic of Ecuador, and it is of interest to note that this is an initial minting of pure nickel coins in the United States.

Net earnings were substantially increased by the higher average market price of copper which obtained in 1928. Although there will be no appreciable return from Frood copper during 1929, construction and development work on this property will be completed as rapidly as possible. The management expects to mine and refine a substantial portion of the company's output of nickel from this mine during 1930. The higher copper content of Frood ore will then increase the company's output of copper and add substantially to net earnings. There will also be further revenue from precious metals recovered by the electrolytic refining process now employed.

Giesche to Build the First Electrolytic Zinc Refinery in Germany

By Dr. James Rubinfeld
Special Berlin Correspondent

FOR at least two years, or since the separation of eastern Upper Silesia from Germany, this country has had no adequate reduction plant for the production of zinc. As is common knowledge, all such plants were granted to Poland, where, for example, Giesche Spolka Akcyjna, controlled by Anaconda, is being overhauled and the ancient plants are to be brought up to date. The German and thus far independent part of Giesche's Heirs has abundant zinc-ore reserves in the Bleyscharley field; that is to say, in western Upper Silesia; but has been left entirely without the means of reducing them, so that the owners of the property are forced to send the ores to the custom smelters of the Hohenlohe and Silesian Mining companies, which are also situated beyond the frontiers. The national pride of Germany and economic necessity have brought the desire to alter this state of affairs to a head, and a detailed project has been outlined for the erection of a large and modern refinery on the spot—that is, in German Upper Silesia—with the financial help of the government, which was to grant a loan at favorable terms. These protracted considerations have ended, however, with the decision of Giesche's to renounce state help, because it has proved too difficult to sell the byproducts, sulphuric acid, from that location under favorable freight conditions. A more desirable location has been found in the very heart of the country near the town of Magdeburg, on the Elbe River.

A detailed plan for the construction of a complex power plant with port facilities on the well-navigated river for shipping raw and finished material from and to Hamburg is nearing fruition. The area under exploitation will comprise 24,710 acres, and the electrolytic refinery, the first one in Germany, will be in operation at least at the beginning of 1933. Its capacity will be 50,000 metric tons annually, thus providing for nearly a fifth of the German zinc requirements. The power plant, in which the town of Magdeburg and the Continentale Gasgesellschaft of Dessau will be interested, will supply Giesche's with about 250,000,000 kw.-hr. annually. Present yearly zinc output of the Bleyscharley field amounts to about 120,000 tons of ore.

With regard to the clauses of the recent Brussels Zinc Cartel, rumors are afloat that the Americans, albeit handicapped by existing legislation, have agreed tacitly to restrict zinc exports at the ratio accepted by the other partners of the cartel respecting output. Presumably, however, this concession extends only to Mexican and Canadian mines under the control of United States companies. As the output restriction amounts to from 7 to 10 per cent, conditions in the European zinc market have improved recently.

I am informed that research work in connection with the substitution of tin plate by pure aluminum has met with considerable success, though commercial application has not yet been attained. The laboratories of the Lautawerke, the chief producers of raw aluminum, are working with the Hoesch-concern, a fine-sheet manufacturer. The principle problem is the avoidance of chemical reactions within food cans. By superseding tin in this field as well as in bearing metal, which is now about complete, Germany will, according to predictions, save many millions of marks.

The Serbian copper mines of the Mines de Bore of the Compagnie Française de Bor, located near the village of Bor and Tchoka-Doulkan, are being developed steadily and satisfactorily. Last year the amount of copper produced was approximately 15,077 metric tons, compared with 12,414 tons in 1917. The present high prices of copper are tending to accelerate the growth of this young undertaking. As for the German Otavi-field concessions in the Union of South Africa, I have it on good authority that the Otavi Exploring Syndicate, Ltd., which had been formed with the participation of British interests for opening up new copper fields in the vicinity of Tsumeb, has thus far given no satisfactory results, because of the seeming exhaustion of that region. The ores of this concern are being smelted mostly in the Belgian Hoboken refinery, and by the Norddeutsche Hütte of the Metallgesellschaft. Moreover, the Otavi Mines Company has developed itself into one of the biggest bauxite producers of the world, having a great part in respective concessions in Hungary, Rumania, Jugoslavia, Greece, and Italy, together with the Vereinigte Aluminumwerke of Lauta through the Bauxit Trust A.G. of Zurich. Likewise, it has further increased its capacities as an important European producer of vanadium-alloys (ferrovanadinfabrik).

The Mansfeld A.G. für Berbau und Hüttenbetrieb of Eisleben has maintained its dividend of 7 per cent for the last year out of earnings of 13,312,539 marks, against 12,672,674 marks in 1927. The higher copper quotations have not yet had an important effect upon the business results as shown in the 1928 operations, but should make themselves felt for the current business year.

In view of the runaway copper market, users in Germany have called upon the government to prohibit the export of old metal with copper contents. Thus far this proposal has met with no favor, because any artificial cheapening of the material by export hindrances will necessarily tend to stand in the way of American and other imports of old copper into Germany. Utilization of old metal in Germany is of paramount economic importance. The Geneva resolutions regarding export alleviations have also had some influence upon the attitude of the government.

Nickel consumers are having good business here. The rolling mill of Bereinigte Nickelwerke vorm Fletimann of Schwerte paid dividends amounting to 12 per cent during 1928.

Iron Cap Copper Company reports net profit of $73,050 before depreciation for the year ended Dec. 31, 1928. The company's mining property near Globe, Ariz., remained closed throughout the year. Iron Cap owns 63 per cent of the capital stock of Tennessee Mineral Products Company, producer of 26,709 tons of feldspar in 1928; and 75 per cent of the stock of Christmas Copper Company. A total of 37,686 dry tons of ore and 1,459,707 lb. of copper was produced at the Christmas mine in 1928. A concentrator with an initial capacity of 400 tons daily is now under construction at the Christmas property by the Southwestern Engineering Corporation. The company expects the concentrator to be in operation by June of this year.

White Pine Copper Company, subsidiary of Calumet & Hecla Consolidated Copper Company, reports a net decrease of $17,546 in current assets during 1928.

Noranda Reports Operating Profit of $3,018,247 in 1928

NORANDA MINES, LTD., operating in the Rouyn district, Ontario, reports operating profit of $3,018,247 for the year ended Dec. 31, 1928. A total of $1,657,991 of the operating profit was written off against prior expenditures. Statement of operations for 1928 follows:

Revenue		
Metal recoveries	$6,160,098	
Miscellaneous income	83,952	
	$6,244,051	
Expenditure		
Cost of metal production, including mining, treatment and delivery	$2,495,324	
Custom ore	132,323	
	$2,627,647	
		$3,616,403
Administrative and general expenses	$122,225	
Interest on bonds	205,930	
Reserved for taxes	270,000	
	$598,156	
Operating profit for year		3,018,247
Less written off		
Bond redemption premium	$27,500	
Organization and administrative expenses, and bond and other interest applicable to prior periods	20,901	
Development and mining—prior periods	265,970	
Prospecting and exploration—outside properties	279,922	
Reserved for depreciation of buildings, plant and equipment	1,063,697	
	$1,657,991	
Balance—Transferred to surplus account		$1,360,256

James Y. Murdoch, president of the company, states that an important development in the history of the organization was the coming into production of the Waite-Ackerman-Montgomery mine, in which Noranda Mines, Ltd., has a substantial interest. This mine is operating at a profit, and an energetic and extensive development program is planned for the current year. An extensive development program has been and is being carried on at the property of Aldermac Mines, Ltd., in which the company owns the controlling interest. A large tonnage of low-grade ore is indicated and possibilities of higher-grade bodies are being investigated.

Noranda Mines, Ltd., has entered into an arrangement with British Metal Corporation, Ltd., and Nichols Copper Company, for the erection of a copper refinery in eastern Canada. Plans for this important development are progressing satisfactorily.

Manager Hibbert in his report of operations states that the outstanding event of the year was the discovery of high-grade ore in "H" orebody on the 600, 725, 850, and 975 levels. This ore was first opened up in No. 3 shaft a short distance above the 975 level, but most of the work has been done on the 975 level. The knowledge so far gained from drifting and diamond drilling would indicate that the richest part of this orebody on the 975 level was at its eastern end close to No. 3 shaft. This end of the orebody narrowed rapidly below the 975 level, and diamond drilling has only been successful in tracing the downward continuation of the orebody at this end for some 200 ft. The western portion of the orebody now appears to be wider than the eastern part, but on the 975 level only a narrow band close to the south boundary appears to be commercial, although there are indications that in depth higher-grade ore will be met with at this end. Taking into account the new discovery, the indicated tonnage of ore at Jan. 16, 1929, as interpreted from the results of drifting, crosscutting and diamond drilling, amounted to 3,097,000 tons, having a gross value of $79,340,000, taking copper at 15c. per pound. The average grade of this ore is approximately 7.31 per cent copper and $3.68 in gold.

The discovery of the high-grade ore in "H" orebody from the 600 level to a point some 200 ft. below the 975 level at the eastern end of the orebody has been responsible for the increase in the ore reserves over last year's. More work still remains to be done to completely outline "H" orebody. It is interesting to note that extensions of the smaller orebodies, both in depth and laterally, have indicated sufficient additional ore in these bodies, although of lower grade, to about equal the tonnage mined and shipped to the smelter last year.

During 1928, the smelter treated 271,926 tons of ore, flux, and concentrates and produced 33,307,937 lb. of blister copper, containing 11.20 oz. silver and 3.18 oz. gold per ton. Work on the concentrator was started at the beginning of the year, but it was October before the concentrator was ready to start operations. Since that time only one-half of the concentrator has been in use, treating ore from the Waite-Ackerman-Montgomery mine. During the last three months of 1928, 4,450 tons of ore was milled, and the resulting copper concentrates were sent to the smelter. In starting up the concentrator various troubles developed, but these are gradually being overcome. During 1928, the work of constructing the smelter, as called for on the original plans, was completed, and a large number of changes and additions to the original plans were made in order to improve the efficiency of operation and to prepare for additional tonnage to be treated in the smelter. During 1929, No. 4 shaft will be sunk to the 1,000 level. A new hoist has been ordered for No. 4 shaft. A complete crushing plant is being constructed in connection with No. 4 shaft and additions will be made to the converter building and a conveying system for handling the flux to the converters installed. Plans are being drawn up or are under way for sundry other alterations which will put the mine and smelter in such condition that by the fall of 1929 between 1,600 and 2,000 tons per day may be treated.

Bingham Mines Reports Sharp Decline in Net Income

BINGHAM MINES Company, operating in Bingham Canyon and the Tintic district, Utah, reports net income of $170,919 in 1928, compared with $311,695 in 1927. The 1928 earnings are the lowest in the history of the company since 1911. Income and surplus accounts for the year ended Dec. 31, 1929, follow:

Income Account

Gross income from operations		
Ore shipments	$874,839	
Royalties	40,862	
Rents and privileges	3,778	
Miscellaneous	1,528	$921,008
Operating expenses		
Smelting, freight, sampling and assaying	$316,327	
Mine operations	199,115	
Insurance, miscellaneous taxes, general expenses	82,254	
Management, office, legal expenses, and federal taxes	39,613	637,311
Net earnings and revenues		$283,697
Mine development		
Prospecting and development of mines		112,431
Net operating gain		$171,266
Debit		
Interest		346
Net income		$170,919

Surplus Account

Surplus, Dec. 31, 1927	$1,997,952	
Net income	170,919	$2,168,871
Less—		
Construction and equipment depreciation	6,133	
Mine depletion and amortization	29,121	
Adjustment, income taxes account 1927	2,300	
Dividends declared—1928	150,000	187,554
Surplus, Dec. 31, 1928		$1,981,317

Imer Pett, general manager, states that metal production amounted to 4,775 oz. gold, 942,762 oz. silver, 15,670,321 lb. lead, 1,456,042 lb. copper, and 200,386 lb. zinc. The Dalton & Lake group at Bingham exceeded its 1927 output, and is being quite extensively developed on the dip and strike of its three producing veins. There was a marked decrease in shipments from the Victoria mine, in the Tintic district, as a result of the depletion of the 135 and 373 orebodies; but in July a new discovery was made from the 233 winze below the 1,300 level, and development work has recently disclosed ore on the 1,350 and 1,550 levels, and an improvement in output is therefore expected. Production from the Eagle & Blue Bell mine was less than in 1927. The ore was relatively low in grade and was obtained largely from old stopes where showings of ore were followed. No work was carried on at the Farragut, but patents were obtained for the North and South groups of claims, so that the company now owns an area of 644 acres of patented mineral ground in the North Tintic mining district.

Operations at the Montana-Bingham, limited to the exploration of the Tiewaukee property on and above the No. 3 tunnel level, were suspended in May, as the work failed to discover a favorable deposit.

London Financial News

By W. A. Doman

Special London Correspondent

London, March 12, 1929—As mentioned in last week's letter, business on the London Stock Exchange has become very quiet, mining shares that previously had been most active being included. The monetary position dominates all, and even trust companies which are always on the lookout for bargains have tightened their purse-strings for the time being. Some of the big corporations, feeling certain that many securities had been forced up beyond current or even near-future values, have lightened their books, and are putting the proceeds either on deposit or in three months' Treasury bills. This policy affords an opportunity of picking up sound shares that nervous holders may be induced to jettison. The action, of course, has lowered quotations, and the public will never buy on a falling market. Even recent favorites such as the Rhodesian copper shares are not, at the moment, attractive, and news of favorable developments fails to stimulate interest. One exception may be mentioned. Ashanti Goldfields announced some remarkable assays. On the No. 21 level, in crosscut No. 11 S.W., the average assay value is 174 dwt. over a width of 13 ft. On No. 22 level, crosscut No. 12 S.W. shows a width of 13 ft. in ore, and an average assay value of 43.2 dwt. The 4s. shares jumped 3s. 3d. to 24s. 6d.

P. K. Horner, M.I.M.M., has written a report on the Luiri Gold Areas of Rhodesia. He states that development has been satisfactory and that the grade of ore is fully up to expectation. He recommends further development on the Natala Hill and Dun Robin properties, and the prospecting of the other areas acquired from Rhodesia Minerals Concession, Ltd.

A company called the Viborita Gold Mines has been floated here, with a capital of £130,000 in 5s. shares. It acquires mining rights over an area of 1,500 acres, situated near Amalfi, in Antioquia, Colombia, which have been examined and sampled by W. E. Thorne, M.I.M.M. He estimates the total quantity of gold-bearing ground at about 45,000,000 cu.yd., of which 30,000,000 cu.yd. are considered to contain an average value of 6½d. Working costs are estimated at £25,000 per annum for fifteen years. The purchase price is £61,000 in fully paid shares.

According to reports current here, the Tamana district of Western Australia, some 700 miles north of Kalgoorlie, may prove to be another new gold-mining field. Government representatives are said to have reported favorably upon it.

Golden Horseshoe and Lake View & Star shareholders have agreed to fuse their interests. Dr. Malcolm MacLaren gives the scheme his blessing, and by it the Lake View & Star will be able to open up the untouched sections of the Horseshoe and the Chaffers properties economically. Even yet the Golden Mile may not be played out. The Ellyou Goldfields has purchased a triple screw Handley-Page Jupiter airplane for communication between the coast and the gold mines in New Guinea. Further discoveries of asbestos deposits in Cyprus have been reported.

STATISTICAL NOTES

Magma Copper Company has increased its quarterly dividend from $1 per share to $1.25, effective with the payment scheduled for April.

United Verde Extension Mining Company recently announced an increase in its quarterly dividend rate from $0.75 to $1 per share, effective with the disbursement due in May.

Exploration Company, Ltd., British investment trust, reports net earnings of £36,260 13s. 7d. for the year ended Dec. 31, 1928. Dividend disbursements during 1928 amounted to £53,885 5s. The shares and interests of the company stand in the balance sheet at £410,573 6s. 6d., or, after deduction of the reserves for depreciation, at £310,573 6s. 6d., which is below their estimated value on Dec. 31, 1928. The company's investments are classified as follows:

	£	S.	D.
Gold and silver mining	241,327	18	3
Copper mining	4,353	16	9
Diamond, tin and other mining	48,285	12	10
Nitrates, oil and timber	42,853	0	7
Industrial	73,752	18	1
	410,573	6	6

The company reports that it has sold a number of its shares of Greene Cananea Copper at very satisfactory prices.

Bethlehem Steel Corporation reports net income, after providing $13,658,335 for depreciation and depletion, of $18,585,922 in 1928. This compares with $15,826,142 for 1927 and $20,246,167 for 1926. Gross sales for the year amounted to $294,778,287, compared with $271,502,891 for 1927. Orders aggregating $295,209,483 were booked in 1928, compared with $280,199,101 in 1927. The report points out that the large rebuilding and modernization program instituted by the corporation in 1923 was completed in 1928. Operations of Bethlehem Steel Corporation averaged 82.0 per cent of capacity during 1928, compared with 73.6 per cent in 1927 and 81.1 per cent in 1926. The report states that the previous record for the production of steel in this country, made in 1926, was exceeded in 1928 by over 3,000,000 tons, an increase of approximately 6.5 per cent. At the end of the year Bethlehem had 56,882 stockholders, compared with 60,764 at the end of 1927. A total of 12,121 employees were holders of 84,854 shares of Bethlehem preferred stock and 26,833 employees were paying installments for an additional 62,034 shares of stock. Average earnings per hour in 1928 (exclusive of general, administrative and selling forces) were 64.2c., as against 63.8c. in 1927.

Newmont's 1928 Earnings Total $7,438,357

Earnings of Newmont Mining Corporation, the W. Boyce Thompson holding company, amounted to $7,438,357 in 1928, after expenses, federal taxes, and other charges, compared with $14,650,000 in 1927 and $4,113,671 in 1926. Profit-and-loss statement for 1928 follows:

Earnings:		
Dividends		$1,849,063
Interest		192,123
Other profits realized		6,287,436
Total earnings		$8,328,623
Expenses:		
Taxes paid and reserves for federal income tax for 1928	$716,522	
Administrative and office expense and salaries	129,080	
Expenditures for investigations and work done on ventures abandoned during the year (net)	44,663	
Total expense and reserves		890,265
Net profit for the year 1928—to earned surplus account		$7,438,357

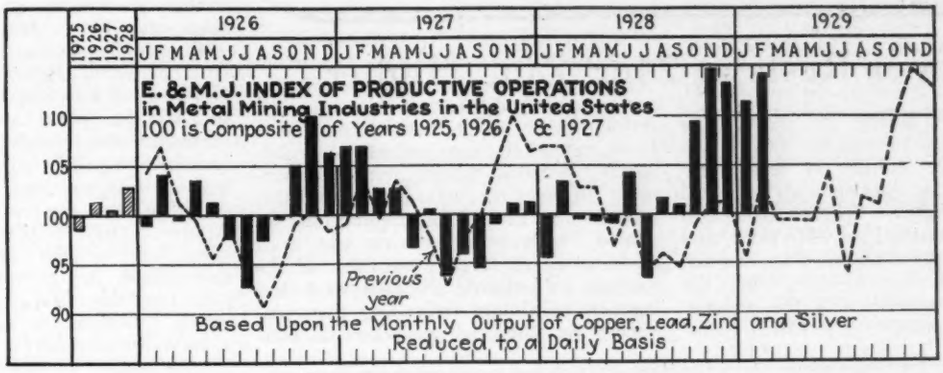
Charles F. Ayer, president of the company, states that mining exploration was prosecuted throughout the year. No mines were acquired during the year, but work is proceeding vigorously on three properties in the development of which the corporation has accepted substantial participations. Previous contacts and interests in Africa enabled the corporation to acquire a large stock interest in Rhodesian Anglo American, Ltd., a British corporation organized to acquire the interests of Anglo American Corporation of South Africa, Ltd., and of its associates, in Northern Rhodesian copper properties. The shareholding so acquired is additional to indirect ownership in Rhodesian Anglo American, Ltd., held by virtue of ownership in Anglo American Corporation of South Africa, Ltd.

La Salle Copper Company, subsidiary of Calumet & Hecla, in the Michigan copper country, reports an excess of receipts over disbursements of $6,586 in 1928. No copper was produced during the year, the company having its principal interest in land rental and as a holding company.

American Metal Company stockholders recently voted to confirm the offer of three-tenths of a share of common stock at $60 a share on or before March 15, for each share of common stock held of record Feb. 21. A total of 31,192 shares of American Metal Company 6 per cent preferred stock has been converted into common. There are now outstanding 68,798 shares of preferred and 647,032 shares of common. After March 15 there will be outstanding 840,508 shares of common. A resolution was adopted reducing the capital stock to the extent of 50,000 shares of 7 per cent preferred stock, heretofore exchanged for 6 per cent preferred stock, and the authorized number of shares of common was increased from 1,000,000 to 2,000,000 shares.

Indicators of Industrial Activity

of Significance to Mining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E. & M. J. INDEX OF PRODUCTIVE OPERATIONS
in Metal Mining Industries in the United States
100 is Composite of Years 1925, 1926 & 1927
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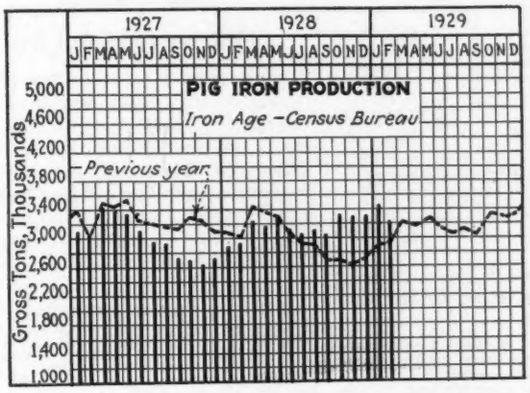
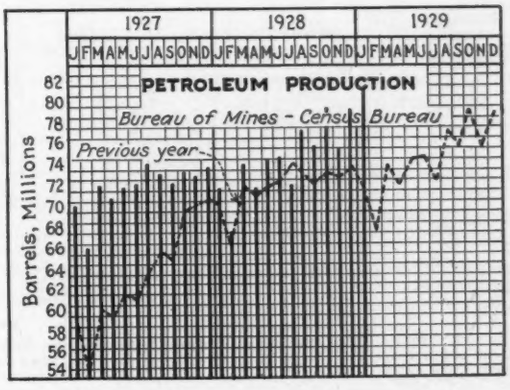
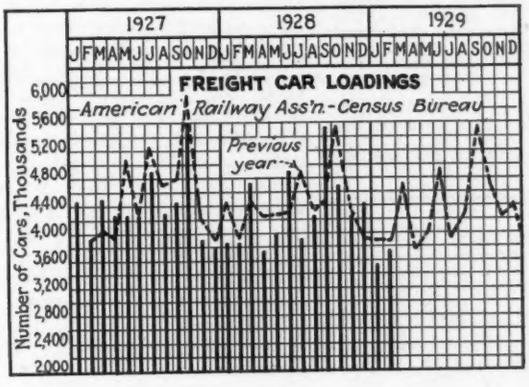
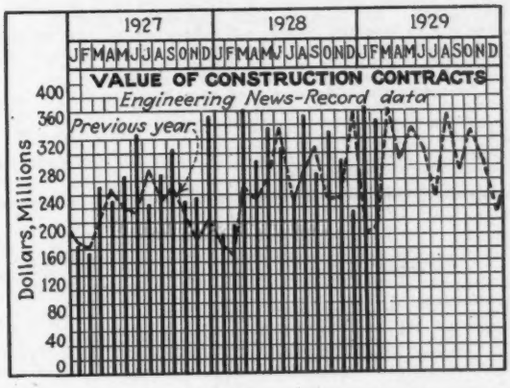
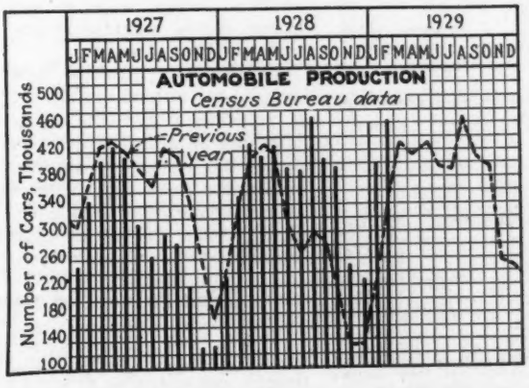
95
90
Previous year
Based Upon the Monthly Output of Copper, Lead, Zinc and Silver
Reduced to a Daily Basis

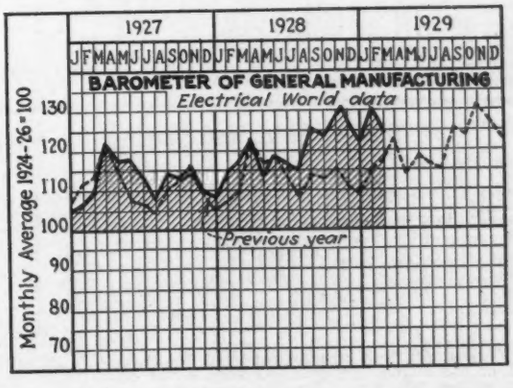












The Market Report

Copper Rests at 24c.; Zinc Higher

New York, March 27, 1929.—The upward march of copper prices appears to have halted, at least temporarily, at 24c. per pound delivered Connecticut Valley. The 24c. price was generally established on March 22, and is the highest price recorded in over ten years, or since Dec. 4, 1918, when the producers' agreement with the government was terminated. The panicky condition of the stock market appears to have had a retarding influence on consuming demand, though some improvement in demand was noted late this afternoon as copper share quotations revealed firmer tendencies on the stock exchanges. A large proportion of the tonnage sold during the past week has been in small lots, indicating that producers are finding it necessary to continue their policy of rationing out their copper to fabricators. Approximately 85 per cent of the tonnage sold in the past week has been for June and July delivery, the greater portion of the earlier positions being for March shipment.

Copper Exporters, Inc., advanced its c.i.f. price to 23⅞c. per pound usual European destinations on March 21, and to 24⅜c. per pound on March 23, the increased differential between domestic and foreign prices being necessitated by higher insurance and interest charges resulting from the higher copper prices. Approximately 56,000 long tons has been sold by the export association this month, though the demand in the past few days has been almost negligible. London in particular appears to have adopted a very bearish position on the copper situation in general, as reflected by the recent declines in electrolytic and standard copper on the London Metal Exchange.

Daily Prices of Metals

March	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
21	22.775	49.375	7.75@7.80	7.70	6.60
22	23.725	49.00	7.75@7.80	7.70	6.55@6.60
23	23.775	48.875	7.75@7 80	7.70	6.50@6.60
25	23.775	48.75	7.75@8 00	7.70	6.60
26	23.775	48.75	7.75@7.80	7.65@7.70	6.625
27	23.775	48.875	7.75	7.65@7.675	6.75
	23.600	48.938	7.788	7.690	6.617

Average prices for calendar week ending March 23, 1929, are: Copper, 22.683; Straits tin, 49.229; N. Y. lead, 7.665; St. Louis lead, 7.563; zinc, 6.483; and silver, 56.458.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

March	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
21	97½	98⅞	107½	222¾	223½	28½	28¾	27 15/16	28⅛
22	97	98⅜	107½	223⅝	223	28 11/16	29	27 13/16	28⅛
25	95⅞	96⅝	111½	220⅝	221½	26⅝	26⅞	27 9/16	27 9/16
26	95⅞	96¾	111½	220	220⅞	26⅜	26 5/16	27½	27 7/16
27	93¼	95½	106½	220⅛	221¼	26⅛	26⅛	27 9/16	27 7/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

March	Sterling Exchange "Checks"	Silver		Gold London	March	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
21	4.84 7/16	56⅛	26 1/16	84s11d	25	4.84 13/16	56½	26	84s11½d
22	4.84 13/16	56⅛	26⅛	84s11¼d	26	4.84⅜	56⅜	26 1/16	84s11½d
23	4.84 13/16	56⅛	26⅛	.....	27	4.84½	56½	26 1/16	84s11½d

Average, 56.479

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command five-eighths cent premium.

Quieter Demand for Lead

The volume of sales of lead in the week ending today has been but little more than half that of the preceding week, and in the last two or three days, since the break in the stock market became acute, demand has lessened very appreciably. Last Thursday producers were either refusing to quote on inquiries or often allotting less than the tonnage asked for. Their offerings became freer in the succeeding days, however, and yesterday and today little or no business was turned down. Prices similarly weakened, the high range of 8c., which obtained in both the St. Louis and New York markets a week ago, no longer being secured. Today's market in St. Louis may be quoted at 7.65@7.70c., the lower figure being about the level at which much of the business of one producer has been done throughout the week. In New York today it seems doubtful if any seller could get more than 7.75c., which remains the contract price of the American Smelting & Refining Company. Before the demand moderated there was considerable inquiry for June and July shipment, which met with little response from producers, though some of this future metal was sold at premium prices. Cable companies have been heavy buyers, though foil, pipe, battery, white lead, ammunition, and mixed metal manufacturers have also been in the market.

London is a little lower than a week ago, so no immediate advance in prices is expected. On the other hand the Mexican situation with respect to shipments has shown no improvement, and should the stock market strengthen, and an active demand for lead return, the metal would be in an extremely firm position.

Zinc Advanced Again

Prime Western zinc has sold in excellent volume during the past week, though considerable difference of opinion as to price appears to have existed.

The 6.60c. price was fairly well maintained until today, but a considerable tonnage changed hands at 6.50 and 6.55c. per pound last Friday and Saturady. The bulk of the tonnage sold yesterday was at 6.60c. also, though one or two small lots brought as high as 6.80c. per pound. Today most producers are asking 6.80@6.85c. per pound, but the tonnage actually sold was done at 6.75c. Delivery well into the second half of the year has been specified on most of the business.

Tin Uninteresting

Tin continues the least interesting of any of the metal markets, with the same factors dominating the situation as have existed for some time. London stocks are increasing despite the heavy shipments to this side. The market has declined a little from a week ago, to about 48.875c. today for prompt, with forward about one-eighth cent higher.

Tone of Silver Market Improves

A better interest has been shown in the demand for silver during the last week, and though prices have not advanced materially, the undertone appears steady at a slightly higher level. India is reported to have been a buyer, and China has operated both ways.

Mexican Dollars (Old Mexican pesos): March 21st and 22d, 42⅞c.; 23d, 42¾c.; 25th, 42½c.; 26th, 42⅝c.; 27th, 42¾c.

Foreign Exchange

Closing cable quotations on Tuesday, March 26, 1929, were as follows: Francs, 3.90⅛c.; lire, 5.23⅜c.; and marks, 23.72¼c. Canadian dollars, ⅜ of 1 per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 9⅝@9¾c. per lb. for all positions. Cookson's "C" grade, spot, 14¾c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM — Per lb., New York: 85@95c. Active demand.

IRIDIUM—Per oz., $260@$265 for 98 @99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $70. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $122 cash. Small lots command the usual premiums.

Prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of March 9.

Metallic Ores

IRON ORE—New prices established for 1929 season at approximately 25c. per long ton above the 1928 prices for all grades of Lake Superior ores. Details will be published next week.

MANGANESE ORE—Per long-ton unit of Mn, c.i.f. North Atlantic ports, exclusive of duty: Brazilian and Indian grades, minimum 47 per cent Mn, 30@32c.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $13.25@$14; Western scheelite, $15. Nominal. China appears sold out through June. European dealers reported refusing to bid on near-by positions.

Chrome, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the March 9 issue.

Lead and Zinc Concentrates Both Higher

Joplin, Mo., March 23, 1929

Blende	Per Ton
High	$43.50
Premium blende, basis 60 per cent zinc	$43.00@ 43.50
Prime Western, basis 60 per cent zinc	42.00@ 42.50
Table concentrate, 60 per cent zinc	39.00@ 41.00
Flotation concentrate, 60 per cent zinc	37.00@ 39.00
Average settling price, all zinc	41.95
Galena	
High	$108.40
Basis 80 per cent lead	105.00
Average settling price, all lead	98.92

Shipments for the week: Blende, 15,173; lead, 2,580 tons. Value, all concentrates the week, $891,390.

Although pig lead was advanced during the week the equivalent of $7 per ton of concentrate, buyers report an advance in price of only $5 per ton. A considerable tonnage was sold early in the week, however, with the understanding that an advance would be made equal to that of the pig lead market, and some concentrate, it is claimed by sellers, was settled for on a basis higher than $105, though the exact price was not divulged.

Zinc concentrate received an advance of $1 to $1.50 per ton on all grades, and sales totaled 17,780 dry tons, equivalent to a wet weight shipment of approximately 20,000 tons. Production was 14,250 tons.

Compared with the January averages the production has increased 2,790; the purchases, 6,650; and shipments, 3,590 tons per week. Stocks were decreased 7,160 tons.

Platteville, Wis., March 23, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$45.25
Lead Ore	
Lead, basis 80 per cent	$105.00

Shipments for the week: Blende, 780 tons; lead, 80 tons. Shipments for the year: Blende, 7,987; lead, 400 tons. Shipments for the week to separating plants, 1,251 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the March 9 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Market firm.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 7c. for either large or small crystals, price effective March 23.

Antimony Oxide, Calcium Molybdate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the March 9 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $33@$34 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.10@$1.15.

NICKEL SILVER—Price advanced to 37¾c. per lb. for 18 per cent Grade A sheets effective March 22.

YELLOW (MUNTZ) METAL—Price for dimension sheets advanced to 28¼c. per lb.; and for rods to 25¼c. per lb., both effective March 22.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium and Ferrovanadium are unchanged from prices in the March 9 issue.

Rolled Metals

COPPER—Price for sheets, hot rolled, advanced to 33¾c. per lb.; and for wire to 25⅞c. per lb., effective March 22.

LEAD SHEETS—Price of full-rolled sheets advanced to 11½ from 11c. per lb.; for clipped sheets advanced to 11¾ from 11¼c. per lb., effective March 20.

ZINC SHEETS—Price advanced from 9¾ to 10c. per lb., effective March 22.

Monel Metal, and Nickel Sheets are unchanged from prices in the March 9 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of March 9.

Iron, Steel and Coke

Iron—Per gross ton, Valley furnaces, Bessemer, $18.50; basic, $17.50@$18; No. 2 foundry, $18.

Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $34; plates, structural shapes, and soft steel bars, per 100 lb., $1.90@$1.95.

Coke—Per gross ton, Connellsville furnace, $3.00. Connellsville foundry, $3.75@$4.85. Byproduct coke, Ohio and Kentucky, $8; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ending March 23, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	174⅞	161⅛	164⅝	Mr.29,My.20 Q	1.75
Andes Copper	New York	67⅛	61⅛	62	Mr.29, My.6 Q	0.75
Arizona Com	Boston	4⅞	4⅛	4⅛	Ja. 16, Ja. 31 S.A.	0.25
Calumet & Ariz	New York	142⅛	135	135	Mr.7, Mr.25 Q	1.50
Calumet & Hecla	Boston	59⅛	55⅛	55⅛	Fe. 28, Mr. 30 Q	1.00
Cerro de Pasco	New York	117⅛	109	110	Ja. 11, Fe. 1 Q	1.25
Chile Copper	New York	127⅛	117⅛	120⅛	Mr.22, Ap.22 Q	0.87½
Con. Coppermines	N. Y. Curb	18	15⅛	16⅛		
Copper Range	Boston	32⅛	30⅛	31⅛	Mr.15, Ap.15 Q	0.50
East Butte	Boston	5	4⅛	4⅛	Dec., 1919	0.50
Granby Con	New York	102⅞	96⅛	98⅛	Ja. 4, Fe. 1 Q	1.00
Greene Cananea	New York	197⅛	178	178⅛	Mr. 7, Ap. 1 Q	2.00
Howe Sound	New York	82⅛	77⅛	78⅛	Mr. 30, Ap. 15 Q	1.00
Hudson Bay	N. Y. Curb	20⅛	19⅛	19⅛		
Inspiration	New York	64⅛	60	60⅛	Mr.14, Ap. 1 Q	1.00
Isle Royale	Boston	35	32⅛	32⅛	Fe. 28, Mr. 30 X	0.50
Kennecott	New York	104⅛	95⅛	95⅞	No. 30, Ja. 2 Q	2.00
Magma Copper	New York	82⅛	77⅛	79⅛	Mr.30, Ap.16 Q	1.25
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Miami Copper	New York	54⅛	50	51	Fe.1, Fe.15 Q	0.50
Mohawk	Boston	55⅛	50	54⅛	Ja. 26, Mr. 1 Q	1.50
Mother Lode	New York	6	5⅛	5⅞	De.14, De.31 SA	0.20
Nevada Con	New York	62⅞	56⅛	57⅛	Mr.15, Mr.30 Q	0.75
New Cornelia	N. Y. Curb	48	44⅞	45⅛	Fe. 1, Fe. 18 Q	0.50
Noranda	N. Y. Curb	61⅛	55⅛	55⅛		
Ohio Copper	N. Y. Curb	3⅞	3⅛	3⅛	Sept., 1926	0.03
Old Dominion	Boston	17⅛	16⅛	16⅛	Dec., 1918	1.00
Phelps Dodge, old		350	320	320		
Phelps Dodge, new	N. Y. Curb	86⅛	82⅛	83	Mr. 15, Ap. 1 Q	2.5
Quincy	Boston	46⅛	44	44⅛	March, 1920	1.00
Roan Antelope	N. Y. Curb	48⅛	47	47		
St. Mary's M. L.	Boston	46	42⅛	44	Fe.25, Mr.12	2.00
Seneca Copper	New York	10⅛	7⅛	9		
Shattuck Denn	N. Y. Curb	25⅛	23⅛	23⅛		
Sherritt-Gordon	Toronto	9.75	8.25	8.50		
Tenn. C. & C.	New York	20⅛	18⅛	18⅛	Fe.28, Mr.15 Q	0.25
United Verde Ex	N. Y. Curb	26	18⅛	21⅞	Ap. 4, My. 1 Q	1.00
Utah Copper	New York	353	345	345	Mr. 15, Mr. 30 Q	3.00
Waite-Ack.-Mont	Toronto	1.75	1.50	1.75		
Walker Mining	Salt Lake	3.80	3.70	3.80		
Wenden Copper	N. Y. Curb	2	1⅛	1⅛		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	4⅛	3⅛	4		
Amer. Z. L. & S	New York	49⅛	42⅛	42⅛	May, 1917	1.00
A. Z. L. & S., pfd	New York	111⅛	104	104⅛	Nov., 1920	1.50
Bingham Mines	Boston	54	52⅛	54	Mr.15, Ap.5	0.50
Bunker Hill & S	N. Y. Curb	165	144	160	Fe.28, Mr.5 X	0.75
Butte Cop. & Zn	New York			8⅛		
Butte Cop. Con	Boston Curb	*86	*80	*81		
Butte & Sup	New York	9⅞	9⅛	9⅛	Mr. 15, Mr. 30 Q	0.50
Callahan Zn-Ld	New York	3⅛	3⅛	3⅛	Dec., 1920	0.50
Chief Consol	Salt Lake	3.60	3.50	3.60	Fe. 1, 1928 K	0.10
Consol. Ld. & Zn. "A"	St. Louis	13⅛	11⅞	13⅛	Ap.5, Ap.10	0.25
Constitution	Spokane	*32	*28	*32		
Dayrock	Spokane	2.60	2.59	2.60	Mr.23, Mr.30	0.03
Dickens Consol	Spokane	*14	*9⅛	*11⅛		
Eagle-Picher	Cincinnati	20	18⅛	19⅛	Mr.31, Ap.15 Q	0.20
Eagle-Pich., pfd	Cincinnati			102	Jan. 15 Q	1.50
Erupcion	Boston Curb	*25	*20	*22	Ja. 1, 1928 Q	0.07½
Eureka Bullion	Salt Lake	*82	*76	*81		
Eureka Lily	Salt Lake			1.42½		
Eureka Standard	Salt Lake			4.75		
Evans-Wallower	N. Y. Curb	22⅛	19⅛	20⅛		
Evans-Wal., pfd	N. Y. Curb	84⅛	83	83	Mr.20, Ap.1 Q	1.75
Federal M. & S	New York			301	Je., 1927	10.00
Fed. M. & S., pfd	New York	99⅛	98⅛	98⅛	Fe. 21, Mr. 15 Q	1.75
Gladstone	Spokane	*13⅞	*13⅞	*13⅞		
Golconda	Spokane	1.20	1.05	1.14	Mr.20, Ap.1 Q	0.02
Grandview	Spokane	*57	*53	*55⅞		
Hecla Mining	N. Y. Curb	23⅞	20	21⅛	Fe.15, Mr.15 M	0.15
Highland-Surprise	Spokane	*17⅛	*16	*17		
Jack Waite	Spokane	*14	*13⅛	*13⅛		
Kootenay Florence	Spokane	*18	*16⅛	*16⅛		
Lucky Jim	Spokane	*17	*17	*17		
Lucky Tiger-C	Kansas City	†5.75	†5.25		De.4, De.20 MX	0.12
Mexican Premier	Spokane	1.44	1.38	1.38		
National Lead	New York	173	155	160⅛	Mr. 15, Mr. 31 Q	1.25
Natl. Lead, pfd. A	New York	141⅛	141	141⅛	Mr. 1, Mr. 15 Q	1.75
Natl. Lead, pfd. B	New York	118	118	118	Ap. 19, My 1 Q	1.50
N. J. Zinc	N. Y. Curb	311	307⅛	310⅛		
N. J. Zinc, new	N. Y. Curb	80⅛	78⅛	7⅛		
New Quincy	Salt Lake	3.30	2.35	3.02½		
Noble Five	Spokane	*72	*66	*69		
North Lily	Salt Lake	10.00	9.55	10.00	Jan. 20 Q	0.25
Park Bingham	Salt Lake			*10		
Park Utah	New York	12⅛	11⅛	11⅛	Mr. 19, Ap.10 Q	0.20
Pend Oreille	Spokane	11.00	10.00	10.00		
Rico Argentine	Salt Lake	*49	*46	*48	No. 30, De.15 Q	0.03
Ruth-Hope	Spokane	*47	*45	*45		
St. Joseph Lead	New York	87⅛	76⅛	78⅛	Ju. 8, Ju.20 QX	0.75
Sherman Lead	Spokane	*38	*34	*34		
Silver King Coa	Salt Lake	16	14⅛	16	Mr. 20, Ap. 1 Q	0.25
Silversmith	Spokane	*13	*11⅛	*12⅛	Oct., 1926 Q	0.02
Sunshine Mining	Spokane	1.59	1.50	1.59	De. 20, BM	0.02
Tamarack-Custer	Spokane	*82	*57	*75	Sept., 1924	0.25
Tintic Standard	Salt Lake	15.50	14.75	15.25	De. 23, Ja. 23 X	0.20
Tonopah Belmont	N. Y. Curb	*90	*90	*90	Oct., 1925	0.05
Treadwell-Yukon	Toronto	15.50	13.00	13.00		
United Zinc Smg	N. Y. Curb	1⅛	1⅛	1⅛		
Utah Apex	Boston	6⅛	5⅛	6⅛	Je. 14, Au. 1 K	0.25
Utah Met. & Tun	Boston	2	1⅛	1 1⅛	Dec., 1917	0.30
Whitewater	Spokane	1.00	1.00	1.00		
Yellow Pine	Los Angeles			*15	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	7⅛	7⅛	7⅛		
Barry-Hollinger	Toronto	*30⅛	*25	*29⅛		
Central Manitoba	Toronto	*53	*50	*52		
Coniaurum	Toronto	*50	*40	*50		
Cresson Consol	N. Y. Curb	*94	*90	*92	Mr.30, Ap.10 Q	0.02
Dome Mines	New York	9⅛	9⅛	9⅛	Mr.30, Ap..20 Q	0.25

Stock	Exch.	High	Low	Last		Last Div.
Golden Cycle	Col. Springs	†1.64	†1.61		Fe.15, Mr.1	0.04
Gold Hill	Toronto	*6	*5	*5		
Hollinger	Toronto	8.10	7.50	7.50	Mr.8, Mr.25 FW	0.05
Homestake	New York	73⅛	72⅛	73⅛	Mr.20, Mr.25 M	0.50
Kirland Lake	Toronto.	1.35	1.10	1.15		
Lake Shore	Toronto	24.75	22.00	22.00	Mr.1, Mr.15 Q	0.20
McIntyre-Porc	New York	20⅛	19⅛	19⅛	Fe.1, Mr.1 Q	0.25
Portland	Colo. Springs	†*10	†*9½		April, 1927	0.02
Rand Mines	New York			36⅛	Fe. 21,'28 Am.Sh.	1.52
Siscoe	Toronto	*96	*89	*91		
Sylvanite	Toronto	2.05	1.62	1.85		
Teck-Hughes	Toronto	9.55	8.60	8.65	Ja. 31, Fe. 1 Q	0.15
Tom Reed	Los Angeles			*15	Dec., 1926	0.02
Unity Gold	N. Y. Curb	*97	*94	*94		
Vipond Consol	Toronto	1.16	*88	*91	April, 1927	0.03
Wright-Hargreaves	Toronto	2.15	1.85	1.88	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb			35⅛		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	19⅛	17⅛	18⅛		
Castle-Trethewey	Toronto	*38	*35	*35		
Consol. Cortes	N. Y. Curb			*16		
Dolores Esperanza	N. Y. Curb	1	1	1	July, 1923	0.05
Keeley	Toronto	*45	*42	*42	Mr.15, 1928	0.04
Mining Corp	Toronto	5.40	4.50	4.70	De.14, De.31 SA	0.15
Montana-Idaho	Spokane	*11⅛	*9⅛	*11⅛		
N. Y. & Hond. Ros	N. Y. Curb			16	Ja.16, Ja.26 QX	0.50
Nipissing	N. Y. Curb	3⅛	3	3	Mr.30, Ap.20 Q	0.07½
Premier Gold	N. Y. Curb	2	1⅛	1⅛	Mr.14, Ap.4	0.06
Tonopah Exten	N. Y. Curb			*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	3⅛	3⅛	3⅛	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	*91	*91	*91		
Yukon Gold	N. Y. Curb	*99	*76	*76	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	109⅛	102	102	Fe. 15, R	1.00
Beth. Steel, pfd, 7%	New York	120	119⅛	119⅛	Mr.4, Ap.1 Q	1.75
Cleveland-Cliffs	Cleveland	225	140	215⅛	Ap.15, Ap.25 Q	1.00
Colo. Fuel & Iron	New York	74⅛	67⅛	67⅛		
Colorado F. & I., pfd	New York			133	Fe.11, Fe.25 Q	2.00
Great Northern Iron	New York	33⅛	31⅛	31⅛	Dec.15, K	2.00
Inland Steel	New York	96⅛	92⅛	92⅛	Fe. 15, Mr. 1, Q	0.87½
Republic I. & S	New York	97⅛	92	92	Fe. 13, Mr. 1, Q	1.00
Republic I. & S., pfd	New York	110⅛	110⅛	110⅛	Mr.11, Ap. 1, Q	1.75
Sloss-Sheffield S. & I	New York	121	115⅛	115⅛	Mr. 11, Mr.20, Q	1.50
Sloss-Sheff. S. & I., pfd.	New York			108	Mr.20, Ap.1, Q	1.75
U. S. Steel	New York	189⅛	180⅛	181⅛	Fe. 28, Mr. 30, Q	1.75
U. S. Steel, pfd	New York	143⅛	143⅛	143⅛	Fe 2, Fe. 27, Q	1.75
Virginia I. C. & C	New York	25	23	23	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York			45	Jl.16, 1928 SA	2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	170	164⅛	165		
Alum.Co.of Amer., pf.	N. Y. Curb	106	105⅛	105⅛	Mr.15, Ap.1, Q	1.50
American Metal	New York	73⅛	63⅛	65⅛	Fe.9, Mr.1 Q	0.75
Amer. Metal, pfd., 6%	New York	125	121	121	Fe.9, Mr.1, Q	1.50
Amer. Sm. & Ref	New York	112⅛	114	114		
Amer. Sm. & Ref., pfd.	New York	136⅛	135⅛	136	Fe. 1, Mr. 1 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	44⅛	40⅛	41		
Asbestos Corp	Montreal	14⅛	14	14⅛	Jan. 1926	1.50
Asbestos Corp., pfd	Montreal	55	48	48	De. 31, Ja. 15 Q	1.75
Consol. M. & S	Montreal	488	465	475	De.31, Ja.15, SA	X6.25
De Beers Consol	New York	25	22⅛	22⅛	Ja. 19, Ja.26,	0.48
Federated Metals	N. Y. Curb	39	35⅛	37⅛	Mr.27, Ap.5 Q	0.75
Freeport Texas	New York	50⅛	46⅛	47⅛	Ap. 5, My. 1 Q	1.00
Int. Nickel Can	New York	60⅛	50	50⅛	Mr.16, Mr.30 Q	0.20
Int. Nickel, pfd	New York			128	Ap.2, My.1 No.1Q	1.75
Newmont	N. Y. Curb	233⅛	212	217	Mr.30, Ap.15 Q	1.00
Patiño M. & E	New York	47⅛	43⅛	44⅛	Aug. 1928	4s.
So. America G. & P	N. Y. Curb	3	2⅛	2		
Texas Gulf Sulphur	New York	79⅛	75	77	Mr.4, Mr.15 Q	1.00
U. S. Sm. R. & M	New York	72⅛	67	68	De. 31, Ja. 15 Q	0.87½
U. S. Sm. R. & M., pfd.	New York	56	54⅛	54⅛	De. 31, Ja. 15 Q	0.87½
Vanadium Corp	New York	105⅛	96⅛	97⅛	[Fe.1, Fe. 15 Q	0.75

Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Spokane Stock Exchange, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumprion. X, Extra. The first data given is that of the closing of the books; the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED MARCH 5, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	18/9	18/9	18/9		
Alaska Treadwell (£5)	71/3	68/9	70/—	Nov., 1926	4 (d)
Armayo Mines (25 frs.)	69/6	66/10½	68/9	Feb. 1929	5 (c)
Burma Corp (10 rupees)	17/9	17/1½	17/4½	Feb., 1929	7 annas*
Bwana M'Kubwa (5s)	21/9	20/4½	20/9		
Camp Bird (2s)	3/—	2/9	2/10½	April, 1928	16⅓
El Oro (£1)	5/1½	4/7½	5/—	Nov., 1924	2½*
Frontino & Bolivia (£)	9/—	8/7½	8/9	Jan., 1929	3½
International Nickel of Canada (no par value)	$68⅛	$62⅛	$65	Mar., 1929	20(c)
Mexican Corpn. (£1)	11/4½	10/7½	11/—		
Mexican Mines of El Oro (£1)	11/10½	7/6	10/—	Dec., 1926	3½*
Mount Isa (£)	42/6	40/6	41/3		
N'Changa Copper Mining. (£1)	91/3	78/9	80/—		
Oroville Dredging (4s)	2/9	2/6	2/9	Nov., 1928	31½
Rhodesian Congo Border (£1)	121/3	101/3	110/—		
St. John del Rey (£1)	15/6	13/9	14/3	Dec., 1928	2½
San Francisco Mines (10s)	35/1½	34/3	34/9	Jan., 1929	25
Santa Gertrudis (£1)	11/1½	10/1½	10/6	Jan, 1929	7½
Selukwe (2s. 6d.)	7/4½	6/6	7/—	April, 1917	6½
S. Amer. Copper (2s.)	3/6	2/10½	3/3	Nov. 1917	75
Tanganyika (£1)	72/6	68/1½	71/10½	July, 1928	5
Union Miniere de Haut-Katanga (Brussels)	12,700	12,250	12,700	July, 1928	182.60‡

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.

(Price quoted in dollars with a fixed rate of $5 to the £1)